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March, 1898.

ELEVENTH ANNUAL REPORT

OF THE

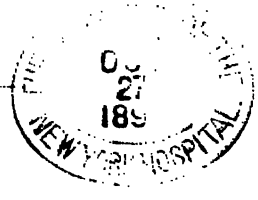
STATE BOARD OF HEALTH

OF THE

STATE OF NEW HAMPSHIRE

FOR THE

YEAR ENDING OCTOBER 31, 1892.



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STATE OF NEW HAMPSHIRE.

OFFICE OF THE STATE BOARD OF HEALTH,

STATE HOUSE, November 1, 1892.

To His Excellency the Governor and the Honorable Council:

In conformity with the laws of the State of New Hampshire, I have the honor to present herewith the Eleventh Annual Report of the State Board of Health, for the fiscal year ending October 31, 1892.

Respectfully submitted,

Irving A. Watson

Secretary.

28760

MEMBERS OF THE BOARD.

Gov. HIRAM A. TUTTLE . . .	Pittsfield.
Att'y-Gen. E. G. EASTMAN . . .	Exeter.
Hon. JAMES A. WESTON . . .	Manchester.
G. P. CONN, M. D., *President* . . .	Concord.
JOHN J. BERRY, M. D.	Portsmouth.
IRVING A. WATSON, M. D., *Secretary* .	Concord.

REPORT.

Herewith is presented the eleventh annual report of the State Board of Health of New Hampshire.

The field of labor in which the Board is engaged has been enlarged from time to time, not only by legislative action, but through the expanding scope of sanitary science. In addition to the specific work for which the Board was created, its duties have been increased by making it a department for the registration of vital statistics, a board of commissioners of lunacy, and the secretary a member of the state board of cattle commissioners, the aggregate of which places a far greater amount of work upon the Board than is represented in this report. In fact, the Board is required to make two other annual reports one of which is nearly as large as this, and which represents no inconsiderable amount of labor.

The science of hygiene is constantly enlarging and to-day embraces, directly and indirectly, engineering, architecture, bacteriology, chemistry, meteorology, topography, law, physics, statistics, as well as the medical sciences. The recognition and development of public hygiene has been almost phenomenal in the last few years. Medical science has revealed the exact nature of some of our most serious diseases, and given to the health officer, as well as to the private family, a knowledge of the means of restriction and prevention. Speculative theories have given way to absolute demonstration, and in the light of recent scientific researches it is not too much to hope that the average duration of human life will soon be considerably prolonged, through the curtailment of some of the leading causes of death. Bacteriology has revealed the exact cause of some diseases, and there is quite a long list of disease-

producing germs now well known and understood. This knowledge enables us to establish methods for the radical prevention and suppression of certain diseases, and for a marked diminution in others.

Within the past year a new field of marvelous possibilities in preventive and curative medicine has been discovered, and the experiments thus far made lead to the belief that we may be upon the verge of a new era in controlling disease. This discovery solves the solution of natural and acquired immunity from certain diseases, and also places in the hands of the medical profession the means of artificially producing immunity from a given disease by the use of substances — *antitoxines* — found in the blood of those persons who have once had the disease. The limited experiments already made in this direction offer the most hopeful evidence of a great and grand triumph over some of the most dangerous and fatal diseases that afflict mankind.

In the special field of sanitation there has been made, during the year, a constant progress, as the result of a wider and more logical presentation of sanitary methods to the public mind, and through the increased efficiency of State and municipal health departments and organizations.

Within a comparatively few years, a great advance has been made in sanitation, with marked results for the public good. The essentials of good health are better understood than formerly. The activity of health organizations has been a source of sanitary education to the people, that has given them a more comprehensive view of the evils of sanitary neglect, as well as positive instruction in the prevention of certain avoidable diseases.

It has been the policy of this Board to present in its annual reports considerable material designed wholly to furnish direct information to the people upon sanitary subjects, instead of giving a detailed account of the work of the Board. This policy, we think, has resulted in a great deal of good, and the plan is continued in this report. We believe that the quickest way to secure sanitary advancement is by enlightening the

people upon sanitary subjects, and in this State we have seen most positive results from this course.

LOCAL BOARDS OF HEALTH.

Every year witnesses an advance in the work accomplished by local boards of health in this State, although it may truthfully be said that the progress in some localities is exceedingly slow. We have, however, many watchful, active, and efficient local boards that are doing an invaluable work for the State and for their own locality in particular. The number of efficient local boards of health increase from year to year, which is also another indication of sanitary progress. In towns where no local board of health is elected or appointed, the selectmen continue ex-officio the health officers of such towns. Perhaps in our smallest towns the selectmen can as well perform the duties of a health officer as an independent board; but in the larger towns the selectmen, as a rule, have not made efficient health officers. The position of health officer should be regarded as second to none in the town; and we believe it would be to the advantage of every town in the State to select a health officer who possesses the requisite qualifications for such a position. It is not always that the board of selectmen is made up of persons who have any special knowledge of sanitary matters; in fact, the board of selectmen is elected for specific duties other than those belonging to the province of the health officer. In many towns this fact is recognized. In some of our towns we have health officers who are always active and watchful, and who never allow the spread of such a disease as scarlet fever, for instance; other towns are not so fortunate in their selection of health officers.

It is the duty of all local boards of health to coöperate in the most effective manner with the State Board of Health. We are gratified with the experience which we have had in this direction. In but very few instances has there been a lack of coöperation. The State Board of Health has occasionally deemed it necessary to issue certain rules and regulations

for the guidance of local boards of health. From time to time circulars of information have been furnished local boards of health for public distribution. The subject of the prevention of contagious diseases has received special attention. The following letter and order was sent to the health officers of every town and city in the State during the present year:

We desire to impress upon your attention the fact that the most efficient agent in the suppression of contagious and infectious diseases is *isolation*. A contagious disease *thoroughly isolated* (followed by complete disinfection) can never endanger the public; therefore it follows, as a logical sequence, that such diseases are subject to absolute control. Unless the isolation and disinfection are complete and absolute there is always danger that the disease may invade other families. The restriction of a contagious disease is not assured unless every avenue for its spread is closed. Measures half carried out leave the gateway open and guarantee no protection to the public. A single spark is as disastrous as a whole firebrand in a magazine of powder.

In order to establish efficient isolation it is, of course, necessary to segregate completely the infected person or family from the rest of the community. Ordering the infected family to remain upon the premises during the period of the disease is by no means the only precaution necessary; the public should be so warned that no person can enter an infected house in ignorance of its dangerous condition. This information can be best conveyed by a placard placed upon the house during the continuance of the disease. This method is already in use in many of our cities and towns, with the best of results. No family having the least interest in protecting the health of the community will object to such a placard; in fact, every considerate, thoughtful, public-spirited family will welcome such action, and in every other possible way will coöperate with the board of health in thoroughly enforcing all measures necessary to restrict the spread of the disease.

So important do we deem this measure that the following rule is ordered to be incorporated among the regulations of every board of health in this State, as provided by the public statutes:

The board of health will placard each and every house in which there is a case of diphtheria or scarlet fever with one or more cards bearing the word "Diphtheria" or "Scarlet Fever," as the case may be, placed upon the front of the infected house in a conspicuous position, preferably near the entrances, so as to be observed and read by

any person approaching the premises. The said card will remain so posted until removed by order of the board of health, and any person removing the same without such an order will be prosecuted according to law.

SUMMER RESORTS.

New Hampshire invites the summer tourists to spend several months each year within her borders. Having extended such an invitation she is under the moral responsibility of offering also every possible guaranty that nothing will be left undone that may contribute to health, or at least to guard the visitor against the dangers of sanitary neglect. We have urged this point for years, and each succeeding season has given evidence that sanitary precautions are receiving more attention with correspondingly good results. In many of our summer resort localities the sanitary conditions are under constant and watchful supervision by the local boards of health that almost absolutely ensures immunity from any of the diseases ordinarily resulting from sanitary indifference or neglect. This watchfulness over the health interests of the summer visitor may be, and perhaps usually is, prompted by the knowledge that the appearance of certain diseases like typhoid fever, for instance, means a greater or less financial loss to that locality for several years to come. So well is this fact understood that capital will not risk the chance of depreciation from such sources, hence sanitary considerations are commonly among the first to be acted upon. Therefore, we have in many of our summer resort towns health officers, who are forced by capital, by the public interests of the place, to be active and vigilant. As a whole, the sanitary condition of our summer resorts is most excellent, and such as may be viewed with confidence by all who contemplate visiting the State for a season of pleasure and recreation.

This Board has made a sanitary inspection of many of our summer resort towns, and in some instances made specific recommendations to local health authorities. The suggestions made are almost without exception promptly carried out. In many instances the local boards have been diligent in study-

ing into the sanitary necessities of certain localities, and not unfrequently have solicited the opinion and coöperation of the State Board of Health in making such sanitary improvements and changes as were deemed best after a thorough investigation.

In no other direction has there been a greater advance in sanitation in this State during the past ten years than in that which pertains to our summer resorts.

CHARITABLE AND PENAL INSTITUTIONS.

These institutions remain in substantially the same condition as shown in the former reports of this Board, although there have been minor improvements at some of them. This Board, by reason of its having no mandatory powers, is wholly unable to cause its recommendations to be carried out. It is due the management of these institutions to say that many of the recommendations have been heeded, especially in instances where the attending expense was small — in an occasional instance where it was considerable. Some of the county almhouses, jails, and so called asylums for the insane are totally unfit for the purposes to which they are put, as we have frequently shown heretofore, but the remedy is not within the powers of this Board. In some counties radical structural defects have been allowed to exist for years, attended with constant danger to life. In view of the facts it would appear that additional legislation is necessary to remedy the gross defects and dangers which exist at some of the almshouses, jails, and asylums for the insane.

BOARD OF CATTLE COMMISSIONERS.

The work of the Board of Cattle Commissioners is so closely related to the public health interests of the State that we deem it worthy of mention in this report.

The Legislature of 1891 enacted a law creating a State Board of Cattle Commissioners "for the purpose of extirpating contagious and infectious diseases, especially tuberculosis among cattle," said law taking effect April 15, 1891. The

Board organized by choosing Irving A. Watson, secretary State Board of Health, president; and N. J. Bachelder, secretary State Board of Agriculture, secretary. Work was at once entered upon and has been prosecuted with earnestness wherever there appeared to be need of action. As stated in the law, the suppression of tuberculosis among cattle was the object sought in its enactment, and in this direction the efforts of the Board have been mainly directed. It is only just to say that the action taken has been sustained by a strong public sentiment and the owners of cattle have generally been willing to coöperate with the Board for the extermination of the disease.

The highest medical authorities recognize the danger to public health from contact with tuberculous animals and from the use of milk and meat of the same, and therefore the work contemplated in the enactment of the law became of the highest importance to the citizens of the State, and of far more significance than that of protecting healthy animals from the disease.

For two years previous to the enactment of the law there had been occasional and spontaneous efforts made to eradicate the disease but there was such a lack of uniformity, so much unnecessary excitement in regard to the work attempted, and so many false reports in regard to the prevalence of the disease and the danger attending it, that the Board entered upon their duties with some hesitation and considerable doubt as to the measure of success that would attend their efforts. The importance of the work was fully realized by the Board, and action under the provisions of the law was entered upon with a full determination to test its efficacy in bringing about the objects sought.

The first important action taken, was the decision to recognize the authority of no veterinary surgeons except such as were duly qualified and held a diploma from some veterinary institution.

By duly adhering to this, the examinations have been made by qualified men and the number of errors in diagnosis have

been surprisingly small. All cases coming to the attention of the Board have been considered, and when the symptoms reported indicated the existence of tuberculosis an examination has been made. In cases where an animal has been killed by the owner and found to be infected, the balance of the herd has been examined. During the period from April 15, 1891, to January 1, 1892, one hundred and eleven condemned animals were killed, and of this number eighty-one were located in Hillsborough county. A circular letter was issued on the last mentioned date from which the following extract is taken:

The extent to which the disease has been found in Hillsborough county caused the Board to investigate the origin and history of certain cases, and in several instances it was traced directly to herds of cattle brought from Massachusetts, either for pasturage or to be sold, sometimes by unscrupulous dealers, to farmers and milkmen of our State. Cases outside Hillsborough county have been traced to the same source. In 1887, when the existence of a case of pleuro-pneumonia was reported in Massachusetts, the State Board of Cattle Commissioners of New Hampshire issued quarantine orders against all cattle from the former State, and cattle were only admitted on permits issued by the Board, on presentation of satisfactory evidence by the owners that such cattle had not been exposed to pleuro-pneumonia. The wisdom of the Board in taking such action was unquestioned, and all possible danger to our live stock interests was averted. Reference to the records of that time show that of the 7,000 cattle admitted under those regulations, over fifty per cent came to Hillsborough county, and doubtless the same percentage of cattle annually brought into the State since 1887 has been landed in the same locality. In this county seventy per cent of the tuberculosis in the State has been found.

These facts have convinced the Board that if any permanent eradication of the disease is effected, regulations must be enforced against the introduction of tuberculous cattle from outside the State, and such action will doubtless be taken at an early date. The comparatively limited area of our State in which the disease exists has also convinced the Board that, with proper action, tuberculosis among our domestic animals, if not completely eradicated, may be greatly suppressed and the danger therefrom to public health reduced to a minimum.

RAILROAD SANITATION.

The railroad companies of New Hampshire have, within the past few years, taken considerable interest in the sanitary condition of their stations and grounds. Within the past five years a very decided improvement in this direction has taken place along all of our lines of railways. It is now the policy of the leading railroads of the State to maintain clean stations with attractive grounds; and, to secure such a result, at least two of the prominent lines have offered prizes to the station agents who keep their grounds in the most attractive condition. Improvements are being constantly made. The Concord & Montreal railroad has during the past year not only built several new stations of the most modern design and construction, but has greatly improved many of the old ones. A like progress has been made by the Boston & Maine railroad, and the Maine Central, which operates many miles of road in the northern part of the State. The advancement in this direction is in keeping with general sanitary progress throughout the State, and contributes not a little to the attraction of our State for summer visitors.

The Concord & Montreal road have recently taken an advanced view of the necessity of good sanitation along its lines by issuing some specific rules and regulations upon this subject. We append herewith the regulations issued by that road, which were approved by this Board September 30 of the current year:

SANITARY REGULATIONS OF THE CONCORD & MONTREAL RAILROAD.

For the purpose of preventing and restricting the spread of any contagious or infectious disease, and to provide as effectually as possible against the presence of any unhealthful or offensive conditions at stations, grounds, or upon trains, the following rules and regulations are issued:

1. All railways stations and grounds adjacent thereto must be kept in a cleanly condition. The waiting rooms, ticket offices, closets, etc., must be swept at least once a day. Store-rooms, baggage-

rooms, freight sheds, etc., must also be kept clean, and the storage of substances liable to decomposition, such as green hides, fish, etc., must not be allowed in any passenger depot. In any combined passenger and freight depot they must not be allowed for a period of more than twelve hours, and if offensive they shall not be stored there at all, but be immediately removed to some unobjectionable place.

2. Water-closets and urinals at stations must be kept sufficiently clean to be free from offensive odors. They should be thoroughly washed at least once a day (urinals oftener in summer unless automatically flushed) with soap and water, and, in addition, disinfectants may be found necessary with faulty fixtures.

Privies should be cleaned out often. Dry earth or freshly slacked lime should be used in the privy daily in sufficient quantities to prevent all odor; by this means a privy can be kept free from danger to the public health, and inoffensive.

3. The water supply of the station must receive careful attention. If from a well near a station or dwelling house, or anything liable to contaminate the water, its use must be prohibited until the condition of the water can be determined by analysis, and for that purpose a sample shall be forwarded to the State Board of Health.

4. The station agent at each station is hereby charged with the execution of the above rules, and will be held responsible for non-compliance, or for any unsanitary condition that may exist at his station, in the same manner as for the non-performance of other duties. Any person having cognizance of unsanitary conditions at any station should promptly notify the Division Superintendent.

5. Water-closets and urinals in railway cars and coaches must be kept at all times clean and free from odors. At all points where cars are cleansed these fixtures must be thoroughly washed and disinfected, for which the parties charged with this duty will be held responsible. When in transit brakemen are charged with the duty of keeping such fixtures clean and inoffensive.

6. Requisition for disinfectants may be made through the usual channel for supplies. Special instructions for the use of disinfectants will also be furnished. It should, however, be borne in mind that disinfectants are required only where complete cleanliness cannot be secured without them. Disinfectants should never be used as a substitute for soap and water, but as an adjunct thereto.

7. Division Superintendents will frequently inspect the sanitary conditions of the stations, grounds, coaches, etc.; they are instructed

to cause the abatement of any sanitary defects for which the road is responsible, as well as like conditions maintained by others detrimental to the interests of the railroad company and the traveling public. To the same end the coöperation of the Division Surgeons is requested.

8. Station agents are required to keep a copy of these rules and regulations posted in the water-closets of their respective stations.

Conductors will be held responsible for the failure of their brakemen to keep the water-closets of passenger cars in a cleanly and inoffensive condition while in transit.

Per order,

T. A. MACKINNON,
General Manager.

Approved by the New Hampshire State Board of Health.

SEPTEMBER 30, 1892.

VACCINATION.

It is now seven years since the public mind has been aroused upon the subject of vaccination in New Hampshire. In 1885, during the prevalence of small-pox epidemic in Montreal, vaccination was very generally practiced throughout the State; but since that exciting period little attention has been given to this important matter. There have been born in this State since that time more than fifty thousand children a large proportion of whom are unvaccinated. The law requiring that all children who attend public school shall be vaccinated, is very imperfectly carried out. In many of our towns it is totally ignored, in others it has been enforced to a limited extent, and in possibly a very few towns efficiently looked after. In addition to the urgent necessity of primary vaccination, a general re-vaccination of the public is recommended.

Within a few months small-pox has appeared in nearly every country in Europe as well as in Mexico, United States, and Canada. Frequent outbreaks have occurred in many of our States, but an epidemic has been promptly averted through the efficient action of the State and local boards of health. There is no other known means of restricting the spread of

small-pox, and but for vaccination it would prevail in epidemic form with the terrible fatality with which it was attended prior to the discovery of vaccination. We recommend to every school board the enforcement of the law relating to vaccination of school children, and to every local board of health the inauguration of a systematic vaccination throughout its respective town or city.

CHOLERA.

The wide-spread prevalence of cholera in Europe during the present year leads the sanitary authorities of this country to be exceedingly apprehensive, lest, during the coming year, 1893, this frightful disease obtain entrance into the United States. As a matter of fact, this country is not well prepared to resist its invasion. Our quarantine service and facilities are, as a whole, lamentably defective, and it is not likely to be made efficacious in season to assure even reasonable protection for the coming year; therefore the most watchful and active duties now devolve upon health organizations, both state and municipal. Government protection against the invasion of cholera into the United States is so exceedingly uncertain that, for the present at least, each state must rely chiefly upon its own efforts.

Unfortunately, we have no national health department qualified to assure protection against the invasion of this disease. The United States Marine Hospital service, in whose hands rests the quarantine functions of the general government, is not a health department in which, as such, the sanitarians of this country, as a rule, have any great amount of confidence. Its quarantine stations are few, and some of them are certainly inadequately equipped in the essentials of first-class service. It is but just, however, to say that the present supervising surgeon general is apparently doing all in his power to improve this service; but it is not to be expected that an efficient national quarantine can, even if the necessary legislation is obtained, be established in season to relieve the state health authorities of the great responsibility that now rests upon them.

If we are to base our judgment upon the history of cholera since its first invasion of this country in 1832, we are brought face to face with an alarming condition. It is only by the most prompt and energetic action on the part of the general government and the health authorities of the several states and municipalites that an epidemic will be averted. New Hampshire, in proportion to her population, is as liable to cholera, if it once gets a foothold in this country, as any other State of the union. Its climatic conditions and geographical position are no barriers to the disease. If once introduced it might spread with fearful results, especially in our manufacturing cities and towns. It, therefore, becomes the duty of the State to provide better means than now exist for preventing its introduction into this commonwealth. A law should be enacted, giving the State Board of Health ample powers to establish quarantine rules and regulations, and to put them, if necessary, into active and efficient operation. An epidemic fund should be appropriated sufficiently large to meet any exigencies that might occur.

REGISTRATION OF BIRTHS, MARRIAGES, AND DEATHS.

Within the last ten years the registration of births, marriages, and deaths in this State has become sufficiently accurate to be of great value in making certain calculations and deductions relative to the people, and bearing intimately upon the welfare of the public. The record of a birth is an obligation due from the State to all that are born within its borders, and not infrequently upon such a record rests some of the most valuable rights of the citizen. The record of a marriage is equally important, and to the wife and children sometimes inseparably connected with property rights, pensions, etc. The record of a death is not only essential in some cases to determine the inherited rights of descendants and relatives, but it is an invaluable and indispensable guide in administering the sanitary affairs of the State. It is unnecessary to specify the many advantages, personal and corporate, that come from a complete record of these events in human

life. The occasional destruction by fire of town and city records emphasizes the importance and wisdom of the State's maintaining such records. So complete and accurate is our registration of deaths that the government caused them to be copied for statistical use in the eleventh census.

The records of births, marriages, and deaths now in the possession of the State, as well as all hereafter returned, are to be classified in dictionary order and placed on file for public reference. By so doing they will be always available and immediately accessible. A place for these records should be provided for in the new library building.

LUNACY.

The State Board of Health constitutes also a State Board of Commissioners of Lunacy, with certain duties to perform, as provided by the Public Statutes. This special work largely increases the labors of the Board. Upon this subject an annual report is made to the Legislature; therefore it is not necessary to mention it here in detail. The wisdom of the law has been proven by the results in the treatment of a certain class of the indigent insane. We are unqualifiedly of the opinion that the benefit extended by the present law to a few should include all the insane in the State.

SECRETARY'S REPORT.

Under the head of "Secretary's Report" in the following pages, will be found some valuable and instructive papers intended to impart sanitary information to the general public. The article on "Scarlet Fever" shows what has been accomplished in a few years in reducing the death-rate from this disease in New Hampshire, and also gives specific instructions regarding the management of this dreaded malady. This paper has been printed in pamphlet form for public distribution by local boards of health and others, and can be had upon application to the Board.

The article entitled "Suggestions for the Prevention and Restriction of Cholera and other Preventable Diseases" gives

specific directions concerning cholera, as well as much general information upon the prevention of any contagious or infectious disease. Many thousand copies of this article, in pamphlet form, have been distributed throughout the State by local boards of health. In some towns a copy has been left at every house.

Considerable attention is given to "Plans for Heating and Ventilating Schoolhouses" in the article prepared by Professor Woodbridge. It is worthy of close study by school committees having in charge the construction of new schoolhouses.

A summary of the causes of death in the State is also given by the secretary; likewise, considerable space is given to the consideration of our most fatal and common disease, phthisis (in common parlance, consumption). This is a subject deserving of much more attention than is being given to it, since it is in the list of preventable diseases. Through our knowledge of this disease, and with the means at our command, there is no question but that its mortality can be very materially reduced.

An interesting and valuable paper is presented by Prof. E. R. Angell, on "Some Foods and their Adulteration." Also, a paper by Prof. R. C. Kedzie, a sanitarian of national reputation, entitled, "The Ground of Safety."

We would especially call the attention of the physicians of the State to the important report by Dr. George M. Sternberg, on "Protective Inoculations against Infectious Diseases." Another valuable paper is the Orton prize essay entitled, "Impure Air and Ventilation of Private Dwellings;" also the paper by Professor Law, on "Tuberculosis in Animals."

These papers have been published in this report under the views that we have long maintained, to wit: That by enlightening the people in sanitary matters the greatest sanitary advancement is made.

NOTE. — The anachronisms which appear in this report are due to the fact that while the report was in press, some matter was added bearing later date than that which terminates the fiscal year of the Board.

SECRETARY'S REPORT.

SCARLET FEVER.

(SOMETIMES CALLED SCARLATINA, CANKER RASH, SCARLET RASH, ETC.)

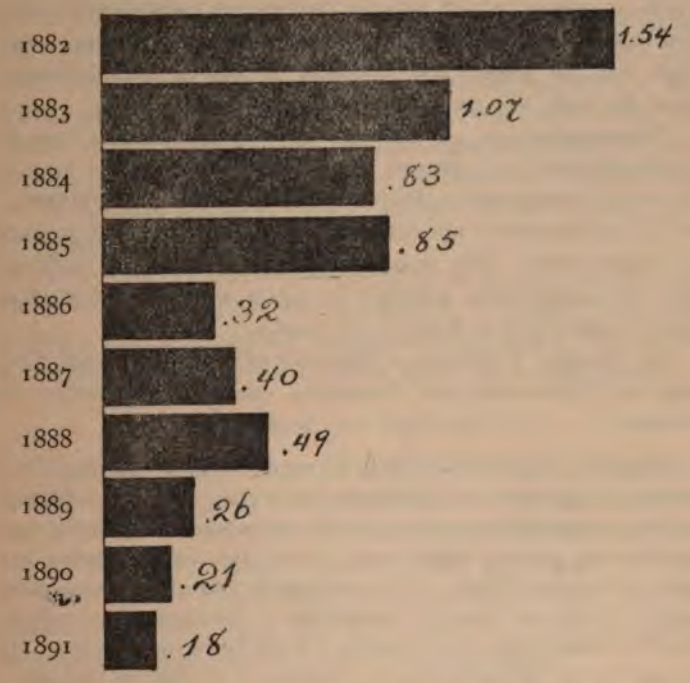
It is but a comparatively few years since scarlet fever was allowed to prevail in New Hampshire, as elsewhere, almost without any attempt at restriction, with a relatively large number of deaths, and with perhaps an equally large number permanently maimed by its destructive effects upon the eye, ear, or other organs of the body. In almost every community there are living to-day evidences of the terrible effects of this disease. Its more extensive prevalence in former times was due largely to the belief, so common among the people, that children must have the disease at some time, and almost total ignorance of its prevention and restriction. So generally wide-spread and so firmly fixed was this idea, that parents even caused their children to be exposed to it when it was "running light," taking the chances that it might be equally mild with them. Thus not a few deaths were caused yearly by the willing exposure of children to this disease, so terrible in its malignant form. In the light of modern sanitation, the absolute and unquestionable error of such a course has been thoroughly demonstrated. A malignant case is not infrequently developed from a mild type of the disease. It has been fully and conclusively proven in this and other states that scarlet fever is pre-eminently a disease to be largely, if not entirely, prevented by means at our command. In the first place it is almost wholly a disease of childhood, and the person who escapes it until adult life, is not likely to become infected with it at all, although there are occasional exceptions.

The statistics of deaths from scarlet fever in New Hampshire during the past eight years, show that the disease is limited almost entirely to early life, ninety per cent of the deaths being of persons under fifteen years of age, while a large majority were under ten. It therefore follows that if parents will protect their children for a few years against the contagion of scarlet fever, the liability to contract it will have almost entirely disappeared. With our present knowledge of the character of this disease, the parent who knowingly allows a child to be exposed to the contagion of scarlet fever should be held guilty of an attempt to take human life, and be punished accordingly.

Every case of scarlet fever is dependent upon a prior case, although it is sometimes impossible to trace the channel through which it came to a person or family. It does not rise spontaneously; it always results from an antecedent case, and is, therefore, one of the diseases which may be stamped out entirely. The results of the work in this direction in this State during the past few years, have been quite remarkable. The State Board of Health practically commenced its work in 1882, and from that to the present time has urged upon the people, the physicians, and the local health authorities, the possibility of bringing this disease under almost absolute control. The great importance of isolation has been urged from time to time upon local boards of health, with the request that it be enforced in every case of scarlet fever, as well as in cases of some other diseases. No better evidence of the wisdom of such action is needed than is afforded by the following diagram, which graphically illustrates the reduction in the mortality from scarlet fever in New Hampshire since 1882. While it is possible that other influences may be to a greater or less extent connected therewith, it is to active sanitary work that the result is chiefly attributable. Were it not for the occasional importation of the disease, we should not hesitate to say that New Hampshire could be entirely freed from scarlet fever in a short time and permanently maintained so. The figures at the right, in the diagram,

indicate the percentage of deaths from scarlet fever to the total mortality of the State, for the respective years given.

REDUCTION OF DEATH-RATE FROM SCARLET FEVER IN TEN YEARS IN NEW HAMPSHIRE.



Under the existing methods of administering sanitary affairs in some localities in the State, we are not sanguine enough to expect that the low rates of 1891 will be maintained for each succeeding year. The indifference of certain towns in the State to the importance and value of an efficient local board of health, is the basis for the foregoing statement. When a town entirely neglects to provide competent men for health officers, it is not to be expected that great progress will be made in the restriction of contagious and infectious diseases in that locality. We cherish the belief, however, that ulti-

mately these towns will fully appreciate the wisdom of maintaining a thoroughly competent board of health.

THE INFECTION OF SCARLET FEVER.

Scarlet Fever is believed to be caused by a special contagium or poison, which may be conveyed to persons previously unaffected, by personal contact, by infected clothing, food, rags, hair, or paper, and probably by any of the discharges from the body of a person affected with the disease.

Communication. It is believed that the disease may be communicated by a person recovering therefrom so long as the usual subsequent scaling or peeling of the skin continues, which sometimes is not completed before the lapse of seventy or eighty days. The poison may also remain in clothing, etc., for a long time, possibly for years, especially if woolen, and packed away in drawers or trunks.

Dr. Jacobi,* Professor of Diseases of Children in the College of Physicians and Surgeons, New York, writes as follows:

> There is no reason to believe in a primary origin of scarlatina. The efficacy of the virus is so persistent, and it clings so long to clothing, bedding, and furniture, that it can be carried and transmitted long distances by persons, towels, toys, letters, and even domestic animals and articles of food. It is transferable through the whole duration of the disease, from the incubation to the disappearance of the very last symptoms. The incubation of scarlatina may last but a few hours, like that of diphtheria or erysipelas, or as long as nine days; in this it differs greatly from measles, variola, and varicella. The last symptoms may not disappear until long after the fortieth day, which, it is true, is the average termination. The fine desquamation of the second week may have terminated entirely, but the gross peeling, particularly of the hands and feet, extends frequently to the end of the seventh or eighth week. It carries contagion as well as the desquamation of the former weeks, or as the breath of the patient, or his expectoration in the earlier periods. So slow is sometimes the process of elimination that Spottiswoode Cameron claims that the end of the disease is seldom reached before the eighth week, and not always in the thirteenth. Whether the urine or the alvine dejections of the

* Archives of Pediatrics, vi, 9.

patient can spread the disease is not quite certain; but so long as there is an uncertainty they ought to be treated as dangerous elements, and disinfected and removed.

The disease is sometimes spread through infected milk. The present year an outbreak of this disease occurred in a town in New Hampshire under the following circumstances: Scarlet fever appeared in the family of a farmer who sold milk in the village, four members of the family having it. The farmer himself had it in a mild form and without knowing the character of the disease. While in the desquamating, or peeling, stage of the disease he milked his cows and sold the milk to five families who contracted the disease from the milk thus furnished.

Period of Incubation. The interval of time which may elapse after exposure to the contagium of scarlet fever, and during which a susceptible person so exposed may expect to be taken sick with the disease, varies from one to fourteen days.

MANAGEMENT OF THE DISEASE.

Whenever a case of scarlet fever appears, or a condition develops which leads to the suspicion that it may possibly be a case of scarlet fever, the patient should be immediately isolated. In other words, the patient should be placed in a room by himself, from which should be excluded everyone but the physician and the nurse, and every known precaution should be exercised to prevent the spread of the disease.

The room to which the case is to be removed should be divested of all unnecessary furniture, such as carpets, rugs, draperies, etc., in order that there may be as few articles as possible to receive the contagium of the disease. The room selected for the patient should be as far removed as possible from the rooms occupied by other members of the family. By this method, and with due precaution upon the part of those attending the patient, a case of scarlet fever may be successfully isolated, even in families having other children.

Suspected cases should be promptly and continuously isolated until it is determined by the physician whether the disease is scarlet fever or not.

NOTIFICATION.

The attending physician, upon his first visit, should advise the family as to the proper isolation of the case, the measures to be taken to prevent its spread, etc. This having been done, he should promptly notify the local board of health, in accordance with section 3, chapter 110 of the Public Statutes, as follows:

It shall be the duty of every physician who attends upon any person infected with the small-pox, the malignant cholera, diphtheria, scarlet fever, or other malignant, pestilential disease, immediately to report the same to the health officers or to the selectmen of the town. If any physician shall neglect so to do, he shall forfeit the sum of one hundred dollars, to be recovered by the health officers or selectmen in the name of the town.

DUTIES OF LOCAL BOARDS OF HEALTH.

The local board of health, upon receipt of the physician's notification, or of like information from any source, should proceed to immediate action, in accordance with the duties devolving upon local boards of health in such cases, viz.: Investigate the matter without delay. See that prompt and thorough isolation of the infected person or persons is enforced. The facts should be ascertained by personal investigation, unless such information is furnished by the attending physician.

See that no person, or family, suffers for lack of attendants or want of supplies. This is especially incumbent upon the local board of health when the disease appears among the poor classes.

A card with the words "Scarlet Fever" upon it must be placed in a conspicuous position upon the house, in accordance with the following regulation issued by the State Board of Health:

The board of health will placard each and every house in which there is a case of diphtheria or scarlet fever with one or more cards bearing the word "Diphtheria" or "Scarlet Fever," as the case may be, placed upon the front of the infected house in a conspicuous position,

preferably near the entrances, so as to be observed and read by any person approaching the premises. The said card will remain so posted until removed by order of the board of health, and any person removing the same without such an order will be prosecuted according to law.

Notify teachers and superintendents of schools concerning families in which there are cases of scarlet fever.

In every case public funerals of persons who have died from scarlet fever must be prohibited. For the protection of the public, no person other than members of the immediate household who have already been exposed to the contagion of the disease should be allowed to attend such funeral.*

At the proper time, after the case is convalescent, the local board of health should see that the rooms, clothing, and all articles likely to be infected, are thoroughly disinfected, in accordance with directions elsewhere given.

The local board of health should close the public schools whenever the disease becomes epidemic in the vicinity, or whenever such action is deemed necessary for the public good. Ordinarily it is not necessary to close a school upon the appearance of this disease. There is no danger to the school, if the children of every family in which the disease exists are excluded. It is seldom that the disease becomes so widespread as to make it necessary to close a school.

*The following regulations issued by this board to local boards, have the force of law:

"By virtue of the authority vested in the State Board of Health by the Public Statutes, it is hereby ordered that, in the rules and regulations adopted by any town or city board within the limits of the State of New Hampshire, the following shall be inserted and included, and that no rule or regulation which will in any way impair the meaning or force of the same shall be adopted by any town or city:

"1. No public funeral shall be held in any instance where the deceased died of small-pox, scarlet fever, or diphtheria.

"2. No pupil shall attend any school, public or private, from a house or family where there exists a case of scarlet fever or diphtheria, unless such case or cases are thoroughly isolated from the said pupil, and then only upon the certificate of a physician, certifying to the fact that such isolation is secured, and that in his judgment no liability to spread the disease will follow.

"3. No person who has had scarlet fever or diphtheria shall attend any school or other public gathering until three weeks after convalescence has been established, except upon the certificate of a reputable physician."

Local circumstances and considerations may suggest to the local board of health, measures other than those herein mentioned. A local board of health has full power to make such regulations for the restriction and prevention of a contagious or infectious disease, in addition to those already existing, as they may deem necessary.

Regulations of local boards of health shall not impair or modify the directions herewith provided.

Every case of scarlet fever should be isolated, inasmuch as a malignant and fatal form of the disease not infrequently arises from exposure to the mildest type of the disease.

CONCERNING THE SICK-ROOM.

Great care should be exercised to prevent the escape of the contagium of the disease from the sick-room. To this end there must be a constant oversight on the part of the attendants. Soiled clothing, towels, bed linen, etc., should be immersed in a tub or pail of boiling water before being removed from the room, and then placed in a disinfecting solution, as elsewhere directed.

The discharges from the throat, nose, mouth, and from the kidneys and bowels of the patient should be received into vessels containing disinfectant Solution No. 2, and in cities where sewers are used thrown into the water-closet, elsewhere the same should be buried at once, at least 100 feet distant from any well, and should not by any means be thrown into a running stream, nor into a cesspool or privy, except after having been thoroughly disinfected. Discharges from the bladder and bowels may be received on old cloths, which should immediately be burned — or disinfected and buried. All vessels should be kept scrupulously clean and disinfected. Discharges from the nose, ears, etc., may be received on soft rags or pieces of cloth, which should immediately be burned.

If the attending physician should think best for the patient, an effort to prevent the spreading of the contagious particles

thrown off from the skin may be made by anointing the body with oil, vaseline, etc., as the physician may direct.

All cups, glasses, spoons, etc., used in the sick-room, should at once, on removal from the room, be washed in Solution No. 1, and afterwards in hot water, before being used by any other person.

Food and drink that have been in the sick-room, or otherwise infected with scarlet fever, should be destroyed or buried. It is best that it should not be put in the swill barrel.

Perfect cleanliness of nurses and attendants should be enjoined and secured. As the hands of nurses of necessity become frequently contaminated by the poison of the disease, a good supply of towels and basins — one containing Solution No. 1, and another for plain soap and water — should always be at hand and freely used.

Filth, uncleanliness, and imperfect ventilation may increase the danger of spreading the disease.

DURING RECOVERY.

Persons recovering from scarlet fever should be considered dangerous, and therefore should not attend school, church, or any public assembly, or use any public conveyance, so long as any scaling or peeling of the skin, soreness of the eyes or air passages, or symptoms of dropsy remain. A person recovering from scarlet fever should not thus endanger the public health nor appear in public until after having taken four times, at intervals of two days, a thorough bath. The hair should be thoroughly washed. This cleansing, however, should be deferred until the physician in charge considers it prudent. After recovery from scarlet fever, no person should appear in public wearing the same clothing worn while sick with, or recovering from, this disease, except such clothing as has been thoroughly disinfected, and this without regard to the time which has elapsed since recovery. Nor should a person from premises in which there is or has been a case of scarlet fever attend any school, Sunday school, church, or

public assembly, or be permitted by the health authorities or by the school board to do so, until after disinfection of such premises and of the clothing worn by such person if it shall have been exposed to the contagion of the disease.

How long patients should be isolated. To a query addressed by the French minister of Public Instruction to the Paris Academy of Medicine, as to how long a child affected with a contagious disease should be kept away from school, the reply was:

(*a*) Pupils stricken with chicken-pox, small-pox, scarlet fever, measles, mumps, or diphtheria, should be strictly isolated from their comrades.

(*b*) For small-pox, scarlet fever, measles, and diphtheria, isolation should not be shorter than forty days; for chicken-pox and mumps, twenty-five days is enough.

(*c*) The pupil, after recovery from one of the above contagious diseases, should not be re-admitted to the school unless furnished with the certificate of a physician that the above precautions have been observed.

HOW TO AVOID AND PREVENT SCARLET FEVER.

Avoid the special contagium of the disease. This is especially important to be observed by children and all whose throats are sore from any cause. Children under ten years of age are in much greater danger of death from scarlet fever than are adults; but adult persons often take and spread the disease, and sometimes die from it. Mild cases in adults may thus cause fatal cases among children. Because of these facts, it is frequently dangerous for children to go where adult persons go with almost perfect safety to themselves.

Do not let a child go near a case of scarlet fever. Do not permit any person or animal to come, or anything to be brought, directly from a case of scarlet fever to a child. Unless your services are needed, keep away from the disease yourself. If you do visit a case, bathe yourself and change and disinfect your clothing before you go where there is a child.

It is probable that the contagium of scarlet fever may retain its virulence for some time, and be carried a long distance in various substances, and articles in which it may have found lodgment. While it is not definitely proved that the germs of scarlet fever are propagated in any substance outside the living human or animal body, it is possible that they may be found to be thus propagated. Therefore, and because the breathing of air laden with emanations from decaying meat, sewers, cesspools, sinks, and other receptacles of filth, is believed to endanger health, great care should be taken to have the house, premises, and everything connected with dwellings kept clean and dry, to have sewer-connections well trapped, house-drains constantly well ventilated, and to have all carriers of filth well disinfected. Do not permit a child to enter a privy or water-closet, or breathe the air from a privy, water-closet, cesspool, or sewer, into which non-disinfected discharges from persons sick with scarlet fever have entered, nor to drink water or milk which has been exposed to such air.

Do not permit a child to ride in a hack or other closed carriage in which has been a person sick with scarlet fever, except the carriage has since been thoroughly disinfected with fumes of burning sulphur, as specified.

Do not permit a pupil of a public school to re-enter school without a certificate of a physician that the proper precautions have been observed.

Do not permit a child to attend school from any family or building in which there is a case of scarlet fever, or has been such, within a period of forty days previous. Public schools are a most prolific source for the spread of this disease.

Do not wear or handle clothing worn by persons during their sickness or convalescence from scarlet fever.

Beware of any person who has a sore throat. Do not kiss nor take the breath of such a person. Do not drink from the same cup, nor use any article that has been used by a person sick with this disease.

DISINFECTION.

There is nothing more inefficiently or uselessly done than the methods frequently resorted to under the name of disinfection. As ordinarily performed in the private family it is a farce worse than useless. Disinfection to be of any use in the destruction of disease germs must be upon exact and scientific principles. The frequent custom of burning a little sulphur in the sick-room has no effect whatever in lessening the disease, and adds greatly to the discomfort of the patient and attendants. Disinfection by fumigation cannot be successfully done without vacating the rooms to be disinfected, and using at least three pounds of sulphur to each 1,000 cubic feet of space.

Clothing, *carpets*, *curtains*, *furniture*, and other substances that are to be destroyed, should be dealt with in a way to avoid conveying the poison to any person in the process; they should not be simply thrown away, or into some stream or body of water; and if burned should be completely burned, and not partly burned and partly warmed, or dealt with in a way to spread the poison of the disease. The glowing furnace under a large engine boiler, or a quick, strong fire in the open air, far from dwellings, is a good place for the burning.

All infected substances, which are not destroyed, should be either thoroughly boiled, subjected to a dry heat of 250° F. in a disinfecting oven, or be thoroughly exposed to fumes of burning sulphur, and afterwards exposed to open-air currents for some days. Books and furs that have been used or handled by those convalescing from this disease are particularly liable to convey the poison to children who have never had it. Great care should be used to thoroughly disinfect any such articles that are not destroyed; and caution should be exercised before allowing children who have not had scarlet fever to handle any such articles that have been used by persons liable to communicate the disease.

DISINFECTANTS TO BE EMPLOYED.

[The following are also applicable in other diseases.]

*Solution No. 1.**

Chloride of lime (bleaching powder), one pound; water, three gallons. Mix.

Care should be taken to obtain *fresh* chloride of lime.

This solution is so cheap that it can be used with great freedom. A quart or more per day may be used in an offensive vault, and such quantities as may be necessary in other places. It may be used in a sprinkler in stables and elsewhere. In the sick-room it may be used in vessels, cuspidors, etc. Sheets and other clothing used by the patient may be immersed in a pail or tub of this solution, diluted, (one gallon of solution to ten of water) for two hours, or till ready for the wash-room or laundry. This solution is non-poisonous, and does not injure clothing.

It may also be used for washing the hands or other parts of the body which may have been exposed to infection from excreta, etc.

Solution No. 2.

Corrosive sublimate, one ounce; permanganate of potash, one ounce; water, eight gallons. Mix and dissolve. (Cost, twenty cents.)

Use the same way and for the same purpose as No. 1. The only advantage this has over No. 1 is the fact that it possesses no odor. It is poisonous, but its bright purple color will prevent its being mistaken for any other solution. It should be used in vessels, cuspidors, etc., in cases of infectious or contagious disease when Solution No. 1 is objectionable on account of its odor. It is not so good a disinfectant for vaults,

*For a free and general use in privy-vaults, sewers, sink-drains, refuse heaps, stables, and wherever else the odor of the disinfectant is not objectionable, this is one of the cheapest and most effective disinfectants and germicides available for general use. It should be used so freely as to *wet* everything required to be disinfected. Its *odor* does not disinfect—only covers up other odors.

sink-drains, sewers, etc., as the chloride of lime solution. It should not be kept in metallic vessels.

Solution No. 3.

Milk of lime. * Milk of lime may be prepared by sprinkling one quart of water gradually upon a quart of quick-lime in broken pieces in a metallic or wooden vessel. When the lime is reduced to powder, three quarts of water should be added, and the whole kept in a covered vessel.

Solution No. 4.

After a case of infectious or contagious disease, a solution made as follows may be used to wash the floor, bedstead, chairs, and other furniture:

Corrosive sublimate, one dram; water, one gallon. Mix and dissolve.†

The walls and ceiling, if plastered, should be whitewashed with a lime wash containing the same proportion of corrosive sublimate, or they may be brushed over with the aqueous solution. Especial care must be taken to wash away all dust from window-ledges, and other places where it may have settled, and to thoroughly cleanse crevices and out-of-the-way places. After this application of the disinfecting solution, and an interval of twenty-four hours or longer for free ventilation, the floors and woodwork should be well scrubbed with soap and hot water, and this should be followed by a second more prolonged exposure to fresh air, admitted through open doors and windows.

A solution of carbolic acid may be employed in the place of Solution No. 4, one part of the pure acid to twenty parts of water. This is also a good general disinfectant for use in the sick-room when its odor is not objectionable.

* This has recently received much favor as a disinfectant on account of its efficiency, cheapness, and lack of unpleasant odor.

† This solution should be used only under the direction of a physician, as it is a poisonous mixture.

DISINFECTION OF PREMISES.

Cellars, yards, stables, gutters, privies, cesspools, water-closets, drains, sewers, etc., should be frequently and liberally treated with Solution No. 1. If the odor of chloride of lime is objectionable, Solution No. 3 may be used. Ordinarily, dry earth or air-slacked lime, if used daily in a privy-vault, will keep it well disinfected and free from odor. This is especially recommended for use at summer cottages, camp-grounds, etc., but to be effective it must be used *daily*, or, better, several times a day.

To keep a privy-vault disinfected during the progress of an epidemic, sprinkle chloride of lime freely over the surface of its contents daily. Or, if the odor of chloride is objectionable, apply daily four or five gallons of Solution No. 3, which should be made up by the barrel and kept in a convenient location for this purpose.

Copperas may also be used to arrest decomposition, but its value is small for any other purpose. It is not efficient in the destruction of the germs of the disease.

DISINFECTION OF THE PERSON.

The surface of the body of a sick person, or of his attendants, when soiled with infectious discharges, should be at once cleansed with a suitable disinfecting agent. For this purpose Solution No. 1 may be used. In diseases like small-pox, diphtheria, and scarlet fever, in which the infectious agent is given off from the entire surface of the body, occasional ablutions with this solution, diluted with ten parts of water, will be more suitable than the stronger solution above recommended.

In all infectious diseases the surface of the body of the dead should be thoroughly washed with one of the solutions above recommended, and then enveloped in a sheet saturated with the same.

DISINFECTION OF CLOTHING.

Boiling for half an hour will destroy the vitality of all known disease germs, and there is no better way of disinfecting clothing or bedding which can be washed than to put it through the ordinary operations of the laundry. No delay should occur, however, between the time of removing soiled clothing from the person or bed of the sick and its immersion in boiling water, or in the diluted solution mentioned under Solution No. 1; and no article should be permitted to leave the infected room until so treated.

Fumigation with sulphur has ever been regarded as a reliable method of disinfecting a house, and should be resorted to after a case of small-pox, diphtheria, or scarlet fever, and in such other cases as the attending physician may think best. To do this, the house must be vacated. Heavy clothing, blankets, bedding, and other articles which cannot be treated with solution, should be opened and exposed during fumigation, as directed below. Close the room as tightly as possible, place the sulphur in iron pans supported by bricks placed in wash-tubs containing a little water; set it on fire by hot coals, or with the aid of a spoonful of alcohol, and allow the room to remain closed for twenty-four hours. For a room about ten feet square, at least three pounds of sulphur should be used; for larger rooms, proportionally larger quantities. Heavy woolen clothing, silk, furs, stuffed bed covers, beds, and woolen articles, which cannot be treated with disinfectants, should be hung in the room during fumigation, their surfaces thoroughly exposed, and their pockets turned inside out. Afterward they should be hung in the open air, beaten and shaken. Pillows, beds, stuffed mattresses, upholstered furniture, etc., should be cut open, and their contents spread out and thoroughly fumigated. Carpets are best fumigated on the floor, but they should afterward be removed to the open air and thoroughly beaten.

Aerial disinfection or fumigation can be completely and entirely effectual only in the absence of living persons, as heat

or fumes strong enough for the purpose are destructive of human life. This need not deter from doing so much as is possible, without injury to sick persons, for the purification of the air of rooms occupied by them — a liberal supply of pure air should be secured;. but after the death or recovery from scarlet fever, the room in which there has been a case of this disease, the furniture and other contents not to be destroyed, should be thoroughly exposed for several hours to fumigation by burning sulphur, and then, if possible, it should for several hours or days be exposed to currents of fresh air.

REMARKS.

Disinfection, following every infectious or contagious disease, should be carried out under the supervision of the local board of health, or by some competent person authorized by the board. Much of the so called disinfection practiced by many families is wholly inefficient and useless. The odor of burning coffee, tar, sulphur, or any other substance in the sick-room, or other part of the house or premises, in the presence of the patient or other persons, operates only as a deodorizer, and does not destroy the germs of the disease. This is an important fact that every family should understand.

In conclusion, we desire to make prominent the fact that scarlet fever can be entirely eradicated by *thorough isolation and disinfection.*

SUGGESTIONS FOR THE PREVENTION AND RESTRICTION OF CHOLERA AND OTHER PREVENTABLE DISEASES.*

I.

PRECAUTIONARY MEASURES.

In view of the wide-spread prevalence of cholera at the present time in Europe and Asia and the imminent danger of its obtaining an alarming foothold in this country and possibly in this State unless unusual and extraordinary precautions

*Issued in circular form for public distribution.

are taken, the State Board of Health issues this circular for the instruction and guidance of local boards of health and the public.

Experience has repeatedly proven that cleanliness is the greatest protection against cholera, as it is against many other diseases, and the appearance of a case or two in a thoroughly clean town or city, if properly managed, need cause no public alarm. It is in the unsanitary places that the disease becomes epidemic and defies human control. New Hampshire, in proportion to her population, is as liable to receive cholera as any other State in the Union. Our thriving manufacturing cities and towns invite the immigrant in search of labor, and the history of cholera outbreaks almost invariably shows that the disease is spread by this class, or through their personal effects. While it is not the purpose of this Board to create the least public alarm over the possibility of the introduction of this disease into this State, we do desire to arouse the public mind to a sense of its duty by taking all the necessary precautionary measures to prevent what might, without such action, be a public calamity.

LOCAL BOARDS OF HEALTH

should commence immediately, if they have not already done so, and unremittingly continue the work of cleaning up — of putting every street, alley, tenement house, back-yard, dwelling, public building, outhouse, schoolhouse, railroad depots, picnic and camp grounds, etc., in the best possible state of cleanliness. They should inaugurate and maintain a thorough system of house to house inspection, and especially in and around tenement house localities and in any other places where unfavorable sanitary conditions exist.

The individual responsibility of the owners of dwellings, as well as of parents and guardians, renders it incumbent upon themselves to place

THE DWELLING AND ITS SURROUNDINGS

in an order of perfect cleanliness. The germs of disease may find lodgment in a dirty and moldy cellar, a neglected vault,

a foul sink-drain, refuse heaps — in fact, whatever the sunlight or air does not purify — unless some special work of purification is done.

CELLARS

should be renovated by removing all vegetables, rotten wood, wet boards, empty boxes, barrels, etc. The cellar windows, should be opened or removed when the weather will permit, and gratings put on, so as to give a free circulation of air through the cellar, for fresh air is the greatest of purifiers. The walls should be swept, and, together with the floor, if cement, should be washed with a solution of carbolic acid, of a strength of an ounce of the pure acid to a gallon of water before being whitewashed. If the floor is of earth, it should be scraped over, all the loose portion carried away, and fresh sand or coarse gravel spread over the surface.

PRIVIES

are attended with much danger to the health of the family, unless properly constructed and well cared for, especially if within a short distance of the family water supply. Every privy should have a water-tight vault, or, better still, a water-tight portable box, in which has been placed a suitable amount of dry earth. Every privy should be supplied with a quantity of dry earth, and a little of the same should be sifted into the box or vault every day. Coal ashes or slacked lime will answer the same purpose. This little daily attention will keep the box or vault in an almost or quite odorless condition. It should be emptied so often as necessary, even if it be once a week. There is no better disinfectant than dry earth, if used as above directed, and a dozen bushels will suffice for a small family for a year. In addition to this, or in lieu of it, disinfectants should be freely used if found necessary.

SINK-DRAINS

are often found more dangerous and greater nuisances than privies. Underground cesspools, made by sinking a barrel or

box in the ground and covering up, are exceedingly dangerous and should never be constructed. The gases arising from such cesspools follow the pipe, or drain, back into the house, and the contents of the cesspool, leaching into the soil, endanger the family well, even if located many feet from it. If no sewer can be reached it is better to allow sink waste to discharge upon the ground in the open air and sunlight; but this should be as far from the house as possible, and not in line with the prevailing winds. A trap which prevents the return of gas, should be put under every sink. At the discharge end of the drain no pit or pool should be allowed to form, as the more the waste is spread out to the air, the quicker are its poisons destroyed. This can be treated with dry earth or dry muck, and thus be kept in good condition, and the product utilized for a fertilizer. Disinfectant fluids should be frequently poured into the sink in order to disinfect the drain-pipe or box, especially in warm weather. In kitchen sinks made of wood, it is better to apply these disinfecting solutions very hot, and they should be used over the whole woodwork of the sink.

WATER-CLOSETS

and set wash-bowls should receive daily attention in order to keep them in good condition. Very much depends upon the plumbing. No fixtures of this kind can be considered perfect or safe, unless well trapped and ventilated. The soil-pipe should always terminate above the roof of the building. Pressure of gas upon the traps is thus prevented, and ventilation secured. In unoccupied rooms containing set wash-bowls, the water should be allowed to run slowly, or else a little turned on every day or two to prevent evaporation and unsealing of the trap. If the house is to be closed for a few weeks, the traps may be filled with kerosene or glycerine to secure them against unsealing by evaporation. The flushing of the closet should be abundant — from two to six gallons at a time. If properly constructed and cared for, no sewer gas can enter; otherwise they may become a serious

element of danger to the household. Direct pressure is not to be depended upon, and supply-tanks, for flushing water-closets and supplying water-backs to kitchen stoves, should always be used.

THE WATER SUPPLY.

The water supply of our cities and most of the large towns is generally from sources of undoubted purity; but to the many residing in the smaller villages, and on farms, there is an ever-present source of danger in wells upon which they are forced to rely for water for domestic uses. Polluted well water is often delicious to the taste, and looks pure and sparkling, and its pollution is not recognized except by tests or by analysis; hence the dangerous poisons and even the germs of disease may be drank without suspicion. Farm-houses, where the danger of such pollution is greatest, as well as villages, should be supplied if possible with water from a good spring, stream, pond, or lake. Such water is the purest that can be obtained, and, with a moderate use of ice during the summer months, is delicious the whole year. The practice of using such water during the cooler months, and drinking the water of a "cool well" in the summer, is attended with great danger. The examination of the water from hundreds of wells in the State, by this Board, has demonstrated that a large majority are polluted and dangerous to health. The only way to protect a well that has not already become contaminated is by the most scrupulous attention to its surroundings. So long as the old privy system is in use, and the sink discharges upon the ground, and stables and hog-pens and refuse heaps are in existence, so long will wells become dangerously contaminated, unless situated a great distance from any of the objects named. Twenty-five, fifty, or even a hundred feet of intervening soil is no guaranty of safety to the well, as the percolating fluids will often go to a much greater distance through certain kinds of earth. During the prevalence of a disease like cholera all drinking-water should be boiled.

ALLEYS AND YARDS

should be kept in a cleanly condition. Rotten vegetables and other household waste should not be thrown about, as is often done, but put into the kitchen range or stove, or carted away before further decomposition takes place. A clean soil is one of the essentials of good health.

AMPLE VENTILATION

should be secured for every room in which people work, live, and sleep. Pure air is indispensable. Sleeping in an ordinary bedroom with windows closed tightly should never be practiced. The atmosphere of such a room soon becomes loaded with the poisonous exhalations of the lungs and skin eliminations, and is rendered unfit for further use. See that every room is thoroughly ventilated. Pure air, pure water, and a soil that is uncontaminated, are primary principles of good health. New Hampshire is abundantly supplied, and with care these

ESSENTIALS OF HEALTH,

coupled with a plain, substantial diet, temperate habits, and regular hours of sleep, will place any household in the best possible condition to resist, not only cholera, but any other disease.

II.

PRACTICAL SUGGESTIONS RELATIVE TO CHOLERA.*

While recognizing the extremely infectious nature of cholera the Board emphasizes the fact that the presence of imported cases ought not to prove a source of alarm to a community if the place receiving the infection has had, and *continues to have*, thorough sanitary care and supervision.

The discharges from the bowels are without doubt the chief source of infection. Vomited matter is open to suspicion and should be similarly treated. In proportion as care-

*Taken largely from a circular issued by the Massachusetts State Board of Health.

lessness and neglect are permitted in the disposal of these discharges, the disease is liable to spread. Under ordinary circumstances, it is probable that a patient suffering with cholera has no power to infect others except by means of such excreta. Nor is it probable that he has any power of infecting at all, except in so far as particles from these discharges may infect the food, water, or air which others consume.

A healthy person coming from an infected district may carry the infection of cholera upon the hands, or other parts of the body, or upon the clothing, and such person should be under the surveillance of the local board of health, and should not be allowed to mingle with the community, and especially should not engage in any occupation by which dust from the clothing, or infection from the person, may enter the food or drink of others, until the board is satisfied that he and his clothes are no longer reasonably open to suspicion as vehicles of disease.

Strong soapsuds may be used for bathing the body. [For the treatment of clothing see instructions relative to *Disinfection.*]

A person arriving in a city or town, who is sick, his illness being known or suspected to be cholera, should not be allowed to dwell in a crowded community, but should be taken to a house having an open space around it, and immediately placed under the charge of a physician. He should be kept warm until the physician arrives. If there should be any doubt as to the character of the illness, the State Board of Health will, upon application, send an expert to decide the question.

The room occupied by the patient should have no carpet, and all articles not immediately needed, including extra clothing and tapestry, that may retain dust, should be removed. Dust upon the floor and furniture should be removed daily by wet cloths wrung out of strong, hot soapsuds, or solution of carbolic acid, and then burned. It would be well to have all the furnishings of the rooms, devoted to the care of the sick, of so cheap a character that they may finally be burned.

The utmost cleanliness should be practiced by the attendant both in regard to his own person and clothing and to the person of the patient, and to all articles in the sick-room; and the attendant should not prepare food for himself, his patient, or others, whereby it would be possible for infection to enter it from his person or his clothing. The hair of the attendant should be closely covered to exclude dust. The dishes and utensils used in the sick-room for food or medicine should not be taken to the kitchen, but should be washed with boiling water, and should be kept separately for this use and not be used by any other person. No food should ever be returned from the sick-room or from the attendant's room to the kitchen.

Special care should be taken in the disposal of the discharges of the sick. They should be treated with an equal volume of the milk of lime. They should not be carried through the house uncovered, and all vessels and their covers and the hands of the person carrying them should be thoroughly washed with solution of carbolic acid. The discharges should be prevented from penetrating the mattress by a covering of rubber-cloth.

The clothing of the attendant and of the patient, and other fabrics used in the sick-room, should be frequently cleansed by boiling. If it becomes necessary to take such clothing to the kitchen or cook-room for the purpose of boiling, they should first be soaked in a saturated solution of carbolic acid for twelve hours.

The attendants should not go into other rooms than those intended for their exclusive use without bathing and change of clothes. Should it be necessary for other persons besides the attendants to enter the sick-room, they should take the same precautions not to carry infection from it upon their persons or their clothes.

In addition to the other precautions which have been mentioned, the following considerations relative to the modes of propagation of cholera should be borne in mind:

a. By leakage from privy-vaults and cesspools, and also by surface drainage, the infective material of the cholera dis-

charges may gain access to wells, or public water supplies, and thus impart to great volumes of water the power of propagating the disease.

b. The careless disposal of choleraic discharges, by suffering them to pass into public or private water-closets, sewers, or cesspools without disinfection, infects the sewage therein contained, and possibly the effluvia evolved by such sewage. The effluvia from privies or even from improperly cleansed vessels which had once contained such discharges may likewise be infectious.

c. The infective power of cholera discharges attaches to bedding, clothing, towels, and other articles which have been soiled with them, and renders them as likely to spread the disease in distant places to which they are sent as in like circumstances the patient himself would be. The infective material of cholera is not discernible by the unaided sense of sight or smell, and may become attached to clothing, linen, bedding, or other articles without being detected by ordinary means. Hence all such articles should be thoroughly disinfected by prolonged boiling or by soaking in the saturated solution of carbolic acid for twelve hours before being removed from the rooms devoted to the care of the sick.

It is also recommended that immediate and thorough examination of the public water supplies should be made by local boards of health, especially when such supplies are liable to the least suspicion of contamination. If pollution is discovered, immediate measures should be taken for preventing its continuance.

The attention of local boards of health is called to the following section of chapter 108 of the Public Statutes:

SECTION 17. Whenever any well, spring, or other water supply is suspected of being polluted by sewage or other matter dangerous to health, the health officers of the town where it is located may cause an analysis of its water to be made by a competent chemist, without expense to the owner. If the analysis shows the water to be unfit for drinking purposes, they may, with the approval of the State Board of Health, prohibit its use, and, if it be from a well, may cause the well

to be closed. The State Board of Health shall authorize such investigations whenever deemed necessary for the public good.

The following existing statutes relative to dangerous infectious diseases should be carefully complied with:

CHAPTER 110.

SECTION 2. The health officers may remove any person infected with the small-pox, the malignant cholera, or other malignant pestilential disease, to some suitable house provided by them for that purpose, if it can be done without endangering the life of the person; and they may make such regulations respecting such house and for preventing unnecessary communication with such persons or their attendants as they may think proper. If any person shall willfully violate the regulations he shall forfeit fifty dollars, to be recovered by the health officers in the name of the town.

SECT. 3. It shall be the duty of every physician who attends upon any person infected with the small-pox, the malignant cholera, diphtheria, scarlet fever, or other malignant pestilential disease, immediately to report the same to the health officers or to the selectmen of the town. If any physician shall neglect so to do, he shall forfeit the sum of one hundred dollars, to be recovered by the health officers or selectmen in the name of the town.

INDIVIDUAL PRECAUTIONS.

The following precautions are recommended to private individuals, and especially to householders:

1. *Domestic Water Supply.* The supply of water for household purposes should be pure, and especially free from contamination by house drainage. Wells located in close proximity to privies and cesspools are always open to suspicion of contamination. If there is any question as to the quality of the drinking-water it should be boiled a half-hour before using.

2. Good, wholesome food should be eaten, such as people have found it best for them to eat at other times.

Fruit should be ripe and sound, and vegetables should be fresh and properly cooked. Excesses in eating and drinking and indigestible food should be avoided.

Care should be taken to secure a milk supply which is above suspicion. In case of an epidemic, all milk should be boiled.

3. Every householder should carefully attend to the condition of the water-closets, privies, cesspools, drains, cellars, stables, yards, out-buildings, and sheds upon his premises, and cause them to be kept in a cleanly condition.

DISINFECTION.

The following disinfectants are recommended:

1. *Milk of lime.* * Milk of lime may be prepared by sprinkling one quart of water gradually upon a quart of quicklime in broken pieces in a metallic or wooden vessel. When the lime is reduced to powder, three quarts of water should be added, and the whole kept in a covered vessel.

2. *Chloride of lime.* (One part of lime to fifty parts of water.) The chloride of lime should be fresh, and may be used either in powder or in solution.

3. *Solution of potash soap.* (Three parts of soap to one hundred of hot water, or one pound to four gallons of water.)

4. *A saturated solution of carbolic acid.* If the crude acid is used it should be dissolved in the warm soap solution, one part of carbolic acid to twenty of the soap solution. Pure acid may be dissolved in water without the soap (one part to twenty).

5. *A temperature of at least 212° F.* (100° C.) for an hour, either by boiling, baking, or steam heat.

MODE OF EMPLOYMENT.

For the disinfection of excreta. The excreta of cholera patients should be received into metallic or earthern vessels and mixed at once with equal parts of milk of lime. Chloride of lime may also be used in the proportion of two heaping tablespoonfuls to each pint of liquid excreta.

For disinfection of the hands, etc. The hands and other parts of the body which may have become exposed to infection

* This has recently received much favor as a disinfectant on account of its efficiency, cheapness, and lack of unpleasant odor.

from excreta, soiled clothing, or bed linen, should be washed in a solution of chloride of lime (one part of lime to fifty parts of cold water) or a saturated solution of carbolic acid.

Bed linen, *shirts*, and such articles as can be washed should be washed in strong soapsuds, and subjected to a boiling heat for half an hour, or they may be placed in the carbolic acid solution for twelve hours.

The clothing which cannot be washed should be subjected to heat above 212° F. Articles of leather and rubber may be treated with the carbolic acid solution.

The *exposed wooden or metallic surfaces of furniture* should be washed with cloths wet with solution of carbolic acid. The floors of sick-rooms should be treated in the same manner. The cloths thus used should be burned.

The *sick-room* should not be used by others until the walls and floors have been scrubbed with cloths wet with solution of carbolic acid, the ceiling whitewashed, and fumigated by burning sulphur, not less than three pounds to each thousand cubic feet of space, with the room tightly closed for not less than twelve hours. The doors and windows should be kept open for at least twenty-four hours afterward to allow a free admission of out-door air.

Concrete, *asphalt*, *brick*, *and other pavements and gutters* exposed to cholera infection should be flooded with milk of lime.

Upholstery, *feather beds*, *and mattresses* should be subjected to steam heat in a disinfecting apparatus. Where this is impracticable they should be destroyed by burning.

Straw and excelsior bedding, *rags*, *old clothes*, and other articles of little value should be destroyed by fire.

The use of proprietary disinfectants and patent remedies for cholera should be avoided.

SUGGESTIONS TO PHYSICIANS.

The Board recognizes that success in the preventive treatment of cholera depends very largely for its efficiency on the willing aid of the attending physician. His position and his

special training enable him to make a proper use of the means for the management and control of the disease, and his daily intercourse with the people makes it possible for him to be very useful in promoting the measures adopted for insuring the public health and in allaying needless panic.

The special points to which the attention of the practicing physicians is directed are —

1. Immediate notice of each case to the local board of health of the city or town in which the case occurs and notice to the State Board of Health by telegraph.

2. In doubtful cases the same precautions as to isolation and disinfection should be employed as in an undoubted case of cholera.

3. Disinfection of the discharges should be practiced as recommended in the foregoing instructions.

4. The patient should be isolated, and where this is impracticable he should be taken to a hospital, or some place provided for the purpose.

5. The nurses and attendants should be carefully instructed as to the disinfection of their hands, their clothing, and the care of the food.

6. Excreta of the sick and other infected material should not be disposed of upon the cultivated soil, nor in the neighborhood of wells, springs, or water supplies, but should be thoroughly disinfected or destroyed by fire.

7. In case of death of the patient the burial should take place as soon as possible and in all cases should be private.

III.

THE GERMAN GOVERNMENT SUGGESTIONS RELATIVE TO CHOLERA.

The following excellent circular embodies the most recent suggestions of the health authorities of the German government relative to CHOLERA. The State Board of Health of New Hampshire has deemed it of sufficient importance to publish the following translation in connection with their own circular upon the subject:

BERLIN, July 28, 1892.

INSTRUCTIONS WITH REGARD TO THE NATURE OF CHOLERA AND CONDUCT TO BE OBSERVED DURING ITS PREVALENCE.

1. The infectious element of cholera is found in the discharges of the sick, and by means of these discharges may be transferred to other persons and to objects of the most varied description, thus diffusing the infection. Some of these objects are articles of clothing, especially underclothing of every description, cloths, articles of food and drink, etc., by all of these the disease may be conveyed from the sick to the well, even when traces of the discharges are present in quantity too small to be perceived by any of the unaided senses.

2. The spread of cholera from one locality to another may therefore easily take place, when a person actually diseased or recovering from the disease, or a person who has been in contact with the sick, leaves his habitual residence and seeks another presumably safer. The objections to such change of residence are, that the person may have been already infected; and, if not, that he will probably fare better under his customary surroundings, pursuing a well regulated habit of life with appropriate precautionary measures, than he would in a strange place or upon a journey.

3. To avoid the danger of introducing the disease into their homes, people should not receive those coming from infected districts. Upon the appearance of cholera in a place, all persons therein are to be regarded as possible carriers of disease.

4. In a cholera epidemic all persons should live a carefully regulated life. Experience teaches that disturbances of digestion favor an attack of cholera; therefore, excesses in eating or drinking, and the use of substances difficult of digestion, should be strictly avoided. Especially are those substances to be discarded which produce diarrhœa or disturb the stomach. Should diarrhœa appear, a physician should be at once consulted.

5. No food should be eaten which comes from a house wherein a person is sick with cholera. Articles of food or drink by means of which the disease can be easily transmitted are to be avoided; such as fruit, vegetables, milk, butter, fresh cheese; or, if taken, should be first cooked. Milk appears to be especially dangerous in its uncooked state.

6. All water that can by any possibility have become polluted by excrement, urine, kitchen waste, or other foul material, should be care-

fully avoided. Water from an inhabited watershed is suspicious, as is also water from swamps, ponds, streams, or rivers, because these are likely to receive drainage from impure sources: especially dangerous is water which can have received the discharges of the sick, no matter how remotely. In this connection especial care must be taken that water in which the garments of the sick, their cooking utensils, or table service, have been washed, shall not obtain entrance to a water supply directly or indirectly, by being poured upon the surface of the soil in vicinity of the water. The best water is furnished by deeply driven pipe wells.

7. If it is not possible to get water above suspicion, it should always be boiled, and only boiled water should be drank.

8. The observations above made in respect to drinking-water apply also to all water used for domestic purposes, because infectious matters existing in waters used for washing dishes and household utensils, for washing and cooking food, for washing and bathing the body, may thus be brought into the human system. In general, a warning should be given that drinking-water is not the only carrier of the disease, and that full protection is not secured even when a pure drinking-water, or one that has been boiled, is used.

9. Every patient with this disease may become the starting-point of an extensive epidemic, and it is therefore advisable not to retain the sick person in a dwelling-house, but to remove him to a proper hospital, whenever possible. If such removal is not practicable, prevent so far as may be all visiting of the sick.

10. No one, unless he be called by duty, should visit a house where cholera exists. Also, in time of epidemic, people ought to avoid crowds, such as fairs, public markets, theatres, and the like.

11. Food or drink should not be taken in rooms where the sick are, also for personal reasons no smoking.

12. As the discharges are especially dangerous, clothing of all kinds that may be polluted thereby should at once be burned, or disinfected as hereafter directed.

13. Especial care should be taken that the discharges do not come near wells or streams used for water supply.

14. Everything that comes in contact with the sick, and which cannot be destroyed or disinfected, should be removed to a specially arranged disinfecting station, there to be made harmless by means of steam; or should be disused for at least six days and set away in a dry, sunny, well aired place.

15. All persons coming in contact with the patient, his bed, or

clothing, should immediately disinfect their hands, especially when they become soiled by the discharges. Emphatic warning is to be given not to touch food with infected hands, or to place anything in the mouth which may have become infected in the sick-room, *e. g.*, glasses, dishes, spoons, forks, cigars, etc.

16. When a death occurs, the corpse should be removed so soon as may be from the dwelling-house to a mortuary. If the corpse cannot be washed in the mortuary, omit the washing. The funeral should be as simple as possible, moreover, persons should not enter the house, and there should be nothing in the nature of a wake.

17. Clothing or other articles belonging to the sick or the deceased must not be used or given away until they have been disinfected; especially must not be sent in their infected condition to other places. Whoever receives such articles from places where cholera exists is earnestly advised to have them properly treated at a public disinfecting station, or to cause them to be disinfected under their own direction. Body clothing, sheets, etc., of cholera patients, should not be washed until disinfected.

18. No other means of protection against cholera than those above given are known, and the public are warned against the use of the regularly vaunted proprietary medicines which are supposed to prevent cholera.

SUGGESTIONS FOR THE MANAGEMENT OF DISINFECTION IN CHOLERA.

A. — The Means to be employed.

1. *Milk of lime.* To prepare this, take one litre (about a quart) of pure, broken quicklime, add to three fourths of a litre (about three fourths of a quart) of water in appropriate vessel; when the lime has taken up the water and become reduced to a powder, add three and one fourth litres (about three and one half quarts) more of water and stir the mixture well; keep in a well closed vessel and shake before using.

2. *Chloride of lime.* This is a satisfactory disinfectant only when freshly prepared and kept in well closed vessels. A good preparation can be recognized by the well known odor of chlorinated lime. It may be used either in form of powder or in solution; the latter to be made by mixing two parts of chlorinated lime with one hundred parts of cold water; after the undissolved portions have settled, the clear fluid should be poured off.

3. *Solution of potash soap.* (So named green, black, soft soap.)

Three parts of soap to be dissolved in one hundred parts of hot water; *e. g.*, one half a kilogram (about one half a pound) soap in seventeen litres (about four and one half gallons) of water.

4. *Solution of carbolic acid.* Crude carbolic acid dissolves imperfectly, therefore is not suitable for use. The so named one hundred per cent carbolic acid of commerce dissolves in the soap solution, and is a convenient form of the acid for use. Take the solution of soap described in section 3, to twenty parts of this warm solution add one part of this carbolic acid and stir in. This preparation keeps well and is a better disinfectant than the plain solution of soap. If the distilled qualities of carbolic acid are used, which, though much dearer, are no better as disinfectants than the above named one hundred per cent carbolic acid, the soap solution is not necessary; simple water suffices as a solvent.

5. *Steam apparatus.* Apparatus arranged for direct application of steam at 100° C., or that arranged for superheated steam, may be employed.

6. *Boiling the articles to be disinfected half an hour at least.* Boiling to be constant and articles to be well covered by the water.

B. — Manner of Use.

1. The fluid discharges, vomit, or excrement, to be mixed in vessels with equal quantities of the milk of lime (A 1). Mixture to stand at least one hour before it is put aside as innocuous. Chloride of lime may also be used, two heaping tablespoonfuls in powder form to be added to each half-litre (pint) of discharges, and to be well mixed. Disinfection will be accomplished in fifteen minutes.

2. Whenever the hands, or other parts of the body, come in contact with infected objects, discharges of the sick, soiled clothing, etc., they must at once be disinfected by thorough washing with the chloride of lime solution, or with the carbolic acid solution.

3. Bed and body linen, as well as other clothing of washable sort, are to be placed in receptacles filled with a disinfecting fluid so soon as infected. The solution for this purpose should be either the soap preparation or the carbolic acid mixture. In the first named these articles should remain twenty-four hours; in the last, twelve hours, before final washing. These articles can also be disinfected in steam apparatus and by boiling with water; but even in this treatment the objects must first be well moistened with one of the above prescribed disinfecting fluids, and enclosed in well secured receptacles or in bags,

or wrapped up in cloths, also wet with disinfecting fluid, in order that employees, who have the handling of these objects before the disinfecting process is completed, may not be unnecessarily exposed. In every case all who touch such articles should at once disinfect their hands, as above directed.

4. Garments not washable are to be disinfected in steam apparatus. Leather articles to be rubbed with carbolic acid solution or chloride of lime solution.

5. Wooden and metallic surfaces of furniture, etc., and other similar objects, to be rubbed repeatedly with rags moistened in carbolic acid solution or soft soap solution. Floor of sick-room to be treated in same way. The rags after use to be burned. The floor can also be treated with milk of lime, which should remain in contact with it at least two hours, and may then be wiped off.

6. The walls of the room and such woodwork as will not be injured by the treatment can be whitewashed. After disinfection of a room has been accomplished it should be left vacant for at least twenty-four hours, and well aired.

7. Soil, pavement, or gutters, fouled by cholera discharges, may be disinfected by copious flooding with milk of lime.

8. In privies a litre of milk of lime should be poured, daily, down each opening. Any receptacles used in the privy-vault to receive excrement should, after emptying the same, be well covered with milk of lime, inside and outside. Wooden seats in privies should be washed with the soft soap solution.

9. In case a sufficient disinfection, as above directed, cannot be obtained, *e. g.*, in the case of stuffed furniture, feather beds, etc., and a steam disinfecting apparatus is not accessible, or if disinfecting solutions are not at hand, then the articles needing disinfection are to be put out of use for at least six days, in a place protected from rain but as much as possible exposed to sun and air, where there can be no access to them.

10. Objects of little value should be destroyed by burning.

ADVICE TO PHYSICIANS AS TO COÖPERATION IN SANITARY MEASURES TO BE CARRIED OUT IN TIME OF PREVALENCE OF CHOLERA.

The success of any measures inaugurated by public sanitary authority depends in no small degree upon the assistance given by physicians in their execution. Their special knowledge enables them to appreciate the significance of measures recommended, and their relations to the public give them abundant opportunity to exert their great influ-

ence in the interest of the public weal. The members of this profession have so often and in so high a degree, in like circumstances, shown their devotion to the public good, that it is not permitted to doubt that here also in the struggle with cholera, both in general and in each individual case, their willing coöperation will be given.

The points at which this activity can be most usefully shown are stated in the following sections.

1. Every suspicious case to be immediately announced to the district medical officer and to the local police authority (by telegraph if possible, — expense to be repaid by officer).

2. Until a definite diagnosis can be made, all precautions as to isolation and disinfection must be observed in the same manner as though the case was undoubtedly cholera.

3. All discharges to be disinfected, as above directed; also all infected objects — clothes, linen, furniture, floors, etc.

4. Patients to be as thoroughly isolated as possible, with special nurse. If this cannot be done in a private house, then admission should be sought to a hospital or other building prepared for treatment of such cases, and provided with sufficient means of disinfection.

5. Full instructions to be given to nurses as to care and disinfection of their own clothing, hands, eating in same room with the sick, etc.

6. Strict attention must be given that infective material is not placed near wells, either by throwing these discharges not properly disinfected, or by washing in their vicinity soiled clothing, dishes, etc. This precaution applies to all sources of domestic water supply. If there is suspicion that such water supply is already polluted, then the local sanitary authority is to be notified, and measures are to be taken that such suspicious water supplies shall be abandoned and the public warned against their use.

7. If the sick person dies before arrival of physician, the corpse and all personal articles are to be kept under supervision and apart until the arrival of the medical officer, or until action is taken by the local police authority.

8. Investigations should be made for the purpose of ascertaining how the infection has taken place in each case, and whether any opportunity has been given for the spread of the disease (by infected articles, etc.); also whether there have been any other suspicious occurrences on the spot.

9. With the occurrence of the first cases in any place, and when the certainty of diagnosis is of the highest importance, a quantity of

the discharges (not too small) should be placed in a clean jar or bottle for purposes of a bacteriological examination. In case of necessity a few drops might answer the purpose, or some of the soiled clothing can be used.

10. Physicians skilled in bacteriological examinations can help materially in hastening a decision, if they will at once proceed with this examination, both by microscopical aid and by plate cultures; and if the case is found to be cholera, they can at once inform the medical authority of the fact, and, if possible, send him a specimen of the slides or plates made.

PLANS FOR HEATING AND VENTILATING SCHOOLHOUSES.*

ARRANGED BY PROF. S. H. WOODBRIDGE.

The systems of warming and ventilation shown in the accompanying figures have been adapted to building plans designed without special regard to arrangements best adapted to effective ventilating work and simplicity of arrangements therefor.

The methods of ventilation shown in the plans are limited to what may be termed the natural as distinct from the mechanical, or forced, and for the reasons: 1st, That many school committees oppose carrying a steam pressure in boilers within school buildings sufficient to run an engine; and 2d, that the service of an attendant capable of running and properly caring for an engine and fan mechanism would demand higher wages than school committees feel justified in paying for janitorial services in small buildings; and 3d, that water power can be advantageously substituted for steam, only when the pressure in the supply main is high, and the water rates are low. When water is supplied through reservoirs into which it is pumped by steam, its price may be anywhere from fifteen to thirty cents per thousand gallons. At twenty-five cents a thousand it costs as much per cubic foot as illuminating gas at $1.87 per thousand cubic feet.

A fair average for work done on every cubic foot of air moved through an easy working mechanical system of venti-

* This paper first appeared in the report of the Maine State Board of Health for the current year. It is through the courtesy of Dr. A. G. Young, Secretary of the Maine Board, that we are allowed to present this valuable paper to the people of New Hampshire. — I. A. W.

lation is ten foot pounds. For supplying a school of 200 scholars with a per capita air quantity of 2,000 cubic feet per hour, the power expenditure would at that rate of work be 66,666 foot pounds per minute. If the water pressure were forty pounds, and the efficiency of the motor were 70 per cent, the volume of water required per minute would be 16.5 cubic feet or 990 cubic feet per hour. If the water pressure were eighty pounds, 8.25 or 495 cubic feet of water per hour.

Thus, while water power may be reasonably chosen on the score of safety and the lower cost of attendance, its use is, under the stated conditions, much more costly than that of steam, especially when the steam escaping from the engine running a fan can be used for heating purposes. If only so low a proportion of the "live steam's" heat as ninety per cent is available in the exhaust steam for heating purposes, and if four pounds of coal per hour are required to generate the steam necessary to develop one horse power of work delivered through the engine to the fan, then 0.8 pounds of coal per hour represents the cost of fuel required for power as against the 990 or the 495 cubic feet of water.

The cost of electric service for motor work varies with localities and the work done. Ten cents per hour per horse power is a fair price for small work. The cost for such work as that above mentioned would, at this rate, be twenty cents per hour, as against the cost of 1,000 or 500 cubic feet of water or .8 of one pound of coal.

The greater surety and equableness in ventilating work attainable by mechanical power, because of its comparative freedom from the disturbing action of winds; the readiness of control of the volume and the direction of air movements made possible by its use; the relatively small size of flues required and the adaptability of a fixed size of flues for all weathers and other variable conditions, give to forced ventilation such advantages that its use should be abandoned only when considerations of safety or economy can be clearly shown to outweigh those in its favor.

In the working out of the accompanying plans it has been

assumed that the consideration of mechanical ventilation could not be entertained in connection with the buildings for which ventilating designs have been asked. The aim of this study has been to embody such features in all the plans as seem essential to effective, reliable, and economical work under the given conditions. These are:

First. Generous inlet areas, so located as to reduce to a practical minimum all interference of wind with the ventilating work. To this end the inlet windows should be so placed as to be exposed to wind action from whatever quarter it may blow. Their aggregate area should be such that in quiet weather the air entering all the windows with moderate velocity will furnish an abundant supply for the building. The area of each windward exposure should be such that under the pressure of wind a full supply of air can enter on that side alone.

Second. The use of check valves, so arranged as to admit the air freely on the windward side of the buildings, and to prevent its escape on the leeward side. These valves may be made of the lightest gossamer rubber cloth, which because of lightness and smoothness and imperviousness, is well suited to the purpose. Its lightness offers little resistance to the movement of air; its smoothness prevents the accumulation of dust; and its imperviousness prevents the leakage of air. If arranged as shown in Fig. 38, Group 1, their action will be found noiseless. For use in places where the currents are strong enough to produce flapping and noise, closely woven and light weight woolen stuff may be used rather than rubber gossamer.

Third. Large and direct air conduits from inlet windows to the heaters at the base of the warm air ducts supplying air to rooms. So far as practicable these conduits should be large chambers rather than "cold-air-boxes." Inlet and conduit areas should be so large as to virtually place the whole out of door atmosphere at the disposal of the heating and ventilating apparatus. The quantities of air moved upward to the rooms from the heaters should be controlled by valves between the

heaters and the rooms, rather than by dampers between the heater and outer air.

Fourth. The placing of the furnace and its smoke flue and other hot pipes within the cold air chamber. The heat yielded from the walls of a boiler or a furnace casing is by this means given to the air moving to the rooms, as is also that yielded by so much of the smoke pipe as can be brought within the chamber. In the case of steam heating, the steam mains are run as far as praticable within the chamber, and are not covered.

Fifth. Such area of warm air flues as to allow a sufficient flow of air for the ventilation of the rooms when the outside air is at or near 50° F.

A ventilating apparatus should be planned for the minimum inside and outside temperature difference, and the heating apparatus for the maximum temperature difference under which the systems are to be depended upon for ventilation and warming. Means must therefore be provided for the effective and easy regulation of air flow and of temperature, according to conditions of weather.

When the outside temperature reaches the upper limit, the ventilating ducts must have their maximum carrying capacity, or area of cross section, and the heating system must be working at its minimum capacity. In cold weather these conditions must be reversed. The effective or working area of the flues should therefore be variable within a range corresponding to inside and outside temperature differences.

In the plans presented, such variation of flue area is made possible by simple means. The flues are given a size adapted to ventilating work when the motive pressure, due to the difference between inside and outside temperature, is least. In the coldest weather the switch dampers at the bottom of the flues can be so placed as to cause all the air entering the flues to pass through the heater, whether steam pipes or furnace. The size of the area for that flow is made such that under the most favorable conditions for strong draught the volume of air moved will be that required for ventilation. When,

on the other hand, the outside temperature reaches the upper limit, the opening of the switch valve enlarges the area for the entrance of air into the flues to the full capacity of those flues, warm air flowing slowly through the heater, and cool air through the freer area of the flue bottom.

When the outside temperature is above 50° or 55° it is not advisable to rely on artificial ventilation alone, unless such ventilation is mechanical, that is by means of fans, or artificial motive power. Artificial ventilation is at best but a far off imitation of and a poor substitute for the natural ventilation of summer, when windows and doors may be open to entering breezes and escaping volumes of air ten or a hundred fold larger than could be moved and distributed through a building by any practicable system of artificial ventilation.

The windows of a schoolhouse, as of any other building requiring free ventilation, should be provided with transoms hinged at the bottom and mounted to swing inward, when necessary, and furnished with protecting side pieces to prevent the lateral discharge of air. So far as practicable such windows should be opened only on the windward side of rooms. When these are open the entering air will be given an upward direction and will mingle with the warmer ceiling air before setting floorward, and will reach the occupants with the least possible draught effect. The steam apparatus, or the furnace would at such times furnish heat for warming the air passed in partly through window tops rather than entirely through the cold air chamber, the mixing of cold and warm air being effected within the rooms rather than within the flues.

Sixth. The use of diffusers at the point of inlet to the rooms.

The purpose of this device is to prevent the movement of the air in contracted and continuous current across a room. Such a current is not favorable to a uniform distribution of the air supplied, and tends strongly to draught production, and the more so as the temperature of the air supplied is low.

The aim of the diffuser is to divide the entering air current into half a dozen or more parts, and to give to each part an

independent direction, so causing the air to more immediately reach different and widely separated parts of the room, and, by sending but a fractional part of the air in any one direction, to reduce the liability to draught effects.

Seventh. The provision for warming the building preparatory to use by the rotation of contained air, rather than by the heating of cold air taken from outside. By this means the warmth of night fires, banked or slowly mulling, may be made effective toward maintaining the building's warmth, and the morning heating may be much more rapidly effected than by supplying out of door and cold air to the heaters, and also with a much less consumption of fuel.

To make such rotation rapid the air movement must be free, conduits large, and frictional resistance low. An inspection of the plans will make it appear that the channels for the air's return to the heaters are as large as halls, stairways, and doors will admit.

Eighth. Large discharge flues furnished with dampers for the regulation of air flow, or for closing the flues when ventilation is not required.

When the motive power producing air flow is chiefly in the supply branch of the system, larger flues must ordinarily be provided for discharge than for supply. The temperature of the discharge flue is lower than that of the supply, and the velocity of air flow is correspondingly less, and areas must be inversely as velocities. Futhermore, the effect of successive enlargement and contraction of channel from the supply flue to the discharge flue, should be offset by reducing the work required to reimpart motion to the air at the entrance to the discharge flue.

If the flues are not made sufficiently large, they must be heated to the point necessary to produce the velocity required to move the desired volume of air. When the contraction of a vent flue is due to the presence of a smoke pipe within it, the imparted heat may compensate for diminished area and increased friction unless they are disproportionate, or the pipe and the flue temperature are not in effective adjustment. It

is not in these plans, considered effective beyond compensating for its own presence.

No general provision is made for the further heating of the discharge flues, since they are proportioned for doing the required ventilating work when the outside temperature is not higher than 50°. But one example of vent flue heating is shown.

Ninth. Provision for warming feet and drying clothing. On economic and hygienic grounds it is best, for purposes of ordinary schoolroom ventilation, to locate the inlet for fresh air in the upper half of the room. One reason for this arrangement is the avoidance of draughts produced by a strong and continuous inflow of air. The more free the ventilation, the cooler the air supply must be; and the cooler the air, the greater the necessity for elevating the currents above the occupied part of the room as well as for diffusing it as thoroughly as possible. If heating rather than ventilation is desired, the warm air should, for the best results, be entered horizontally at the floor. The hallways require thorough warming rather than free ventilation, and in them, therefore, the register should be located at the floor. An additional reason for placing the hall registers at the floor is that the occupants should be able to warm feet and dry clothing by a more rapid process than is possible in the still air of the room however comfortable its temperature.

Tenth. The use, whenever practicable, of successive ventilation. Separate supply and discharge ventilation might be furnished for the halls, the schoolrooms, the wardrobes, the play-rooms, and the water-closets. By such a method of ventilation the air supplied to the halls would for the most part escape unused, whereas if it were passed on to the schoolrooms, it could be made to serve the double purpose of hall and room ventilation. The air within a well ventilated schoolroom is abundantly pure for the ventilation of a wardrobe. If suitable for breathing, it must be equally so for airing clothes. The schoolroom air may, for this purpose, be in part vented through the wardrobe. So also in case of the

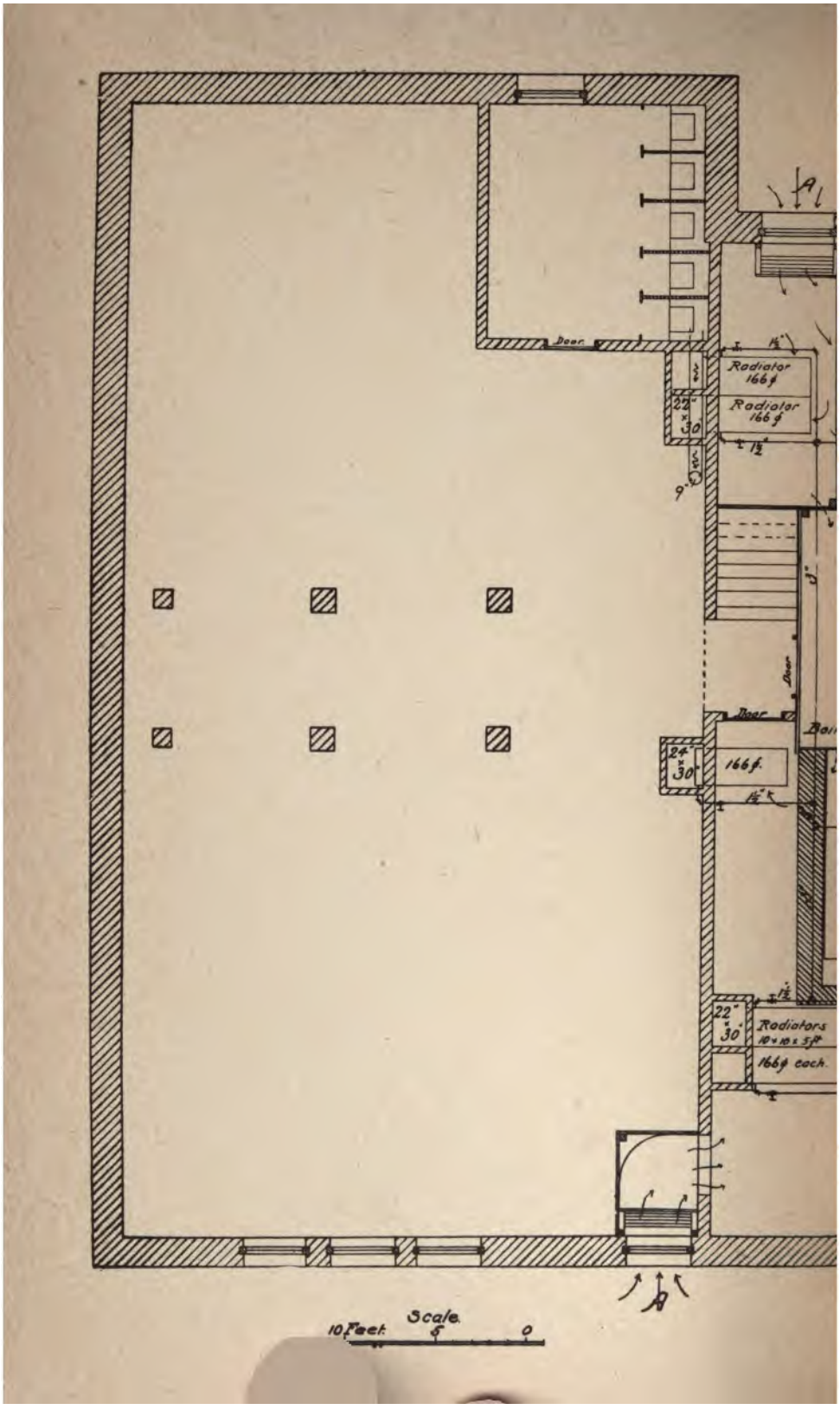
play-rooms,— if the basement rooms are used for that purpose, — they may in cold weather take their supply from the halls, and the water-closets may in turn be supplied from the play rooms. The successive movements must always be, as described, from the better toward the worse, — as from hall, through schoolroom, via wardrobe to vent, — or from hall through play-room via water-closet to vent.

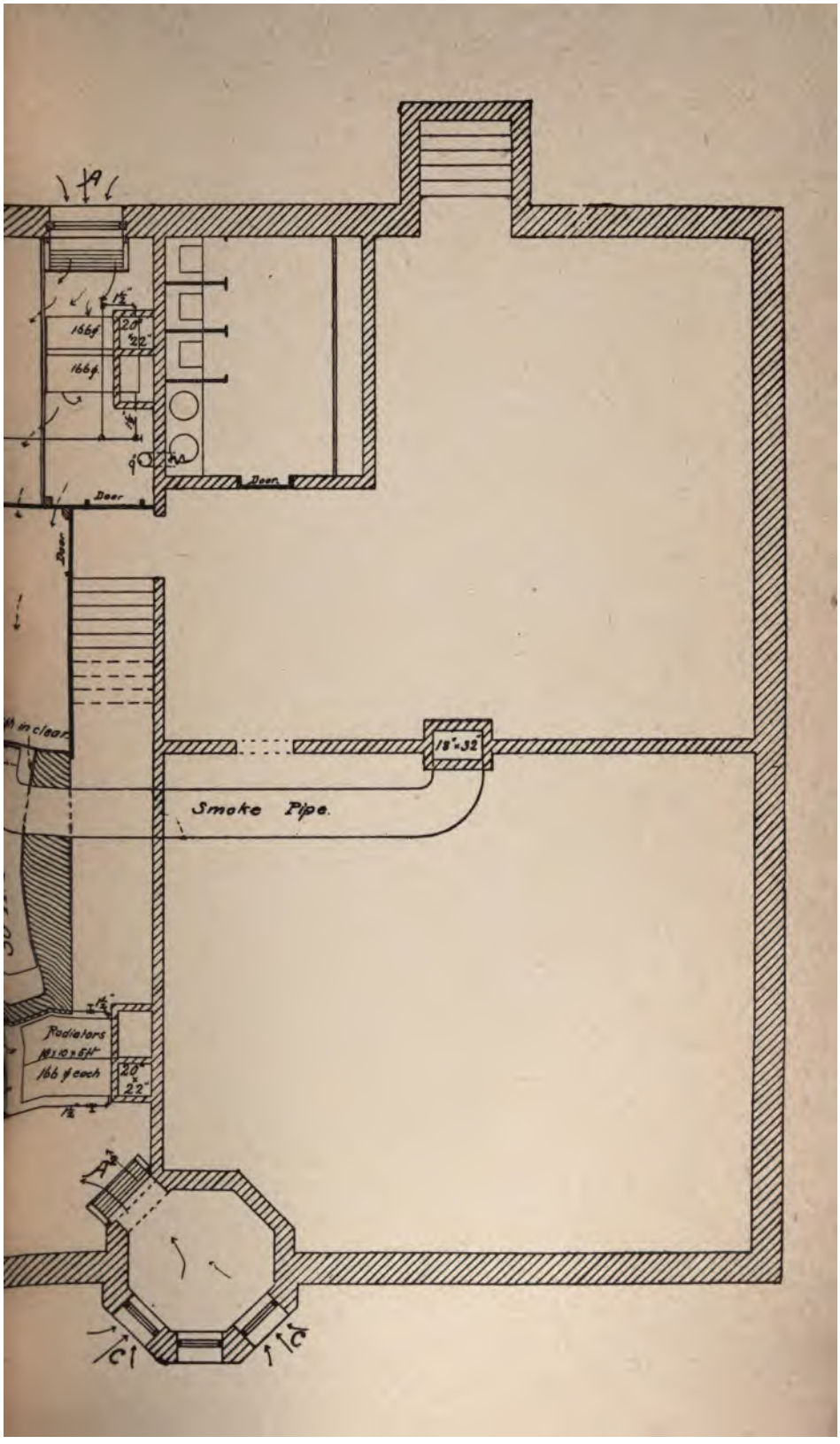
By a well planned application of the successive method, effective ventilation of several apartments may be secured by the use of a smaller volume of air and at a cost considerably lower than would be possible were the apartments equally well ventilated by independent means.

Eleventh. The heating is made entirely indirect, so making the warming of the rooms dependent on and inseparable from ventilation.

A combination of direct and indirect heating has its chief advantage in the effective means it furnishes for warming rooms on the windward side of buildings, so making the equable warming of a building less subject to the interfering effect of wind action, an action which often seriously affects the flow of air through flues, and the distribution of its contained warmth throughout a building. The objection to the use of direct heat is, chiefly, the liability to its abuse. False notions of economy on the part of school committees, the willingness of janitors to win favor with school boards by reducing fuel consumption to a minimum, their temptation to lighten labor by heating with the least tolerable ventilation — since free ventilation of schoolhouses requires more active fires, fifty per cent more fuel combustion and closer attention to, and work upon, fires than does the heating of a box-tight building — all tend to the misuse of direct heating. The sole purpose of direct heating in combination with a ventilating system should be to furnish heat for warming air forced by wind pressure through walls and windows, or to warm the rooms where wind action interferes with the flow of warm air to the windward rooms through the supply flues.

The aim in the arrangement of the ventilating furnishment


A
Door
Radiator
166 f
Radiator
166 f
22" x 30"
1½"
9" Col.
Door
Door
24" x 30"
166 f.
1½"
22" x 30"
Radiators
10 x 10 x 5 R
166 f each.
A
Scale.
10 Feet
5
0


A
1½"
20"
22"
166 ft
166 ft
Door
Door
Door
18"x32"
Smoke Pipe.
Radiators
No 10 x 6 Ht
166 ft each
20"
22"
C
C

for the buildings whose plans have been submitted for the incorporation of such systems has been to reduce the adverse effect of wind to a minimum, and to make its action so far as possible coöperative with ventilating work.

Were forced ventilation employed, and also automatic means for controlling the admission of steam to radiators, and so the temperature of rooms, the method to be recommended would be that of passing air to all rooms at the lowest temperature required for the proper warming of the rooms most easily warmed, and of adding the heat needed in other rooms by direct radiators within them, and under automatic control.

GROUP I.

Figure 36 shows basement plan for an eight-room building. The space included between the corridor walls is appropriated to the purposes of heating and ventilation. It should have a clear height of at least twelve feet. Its floor should be of good concrete with facing of Portland cement. Its ceiling should be wire, lathed and plastered. Within this space are shown two thirty-horse power low pressure boilers, the fire-room, and the coal-hold. The air inlets, provided with check valves, are shown at A, A, A, and C, C. The ceilings of the coal-hold and of the fire-room should be two feet lower than the ceiling of the air chamber, so that a passage of large area may be provided for air movement between the front and the rear parts of the chamber. The stairways to the play-rooms are separated from the air chamber by the partitions shown, and doors placed in those partitions are available for use in warming the building by the rotation method.

The heating surfaces at the bottom of the flues should be so made up as to provide an effective free area for air movement equal to one third that of the flue with which it is connected. The actual free area may be larger than that prescribed, if its character is such as to reduce the freedom of air flow through it.

The form of coil best suited to the conditions of space and work here found is one made up of one hundred one-inch pipes five feet long, arranged ten pipes broad and ten pipes

deep, the lower end being connected with steam chests, and the other in pairs by return bends. Nason tubes should not be used for this work.

These coils may be made in three sections, the two lower ones of four pipes each, and the uppermost of two pipes, and each section having its own supply valve and independent discharge.

The area of opening between the top of the upper steam chest and the bottom of the flue wall should be made equal to one third the area of the cross section of the flue under which the coil is placed. See Figure 37.

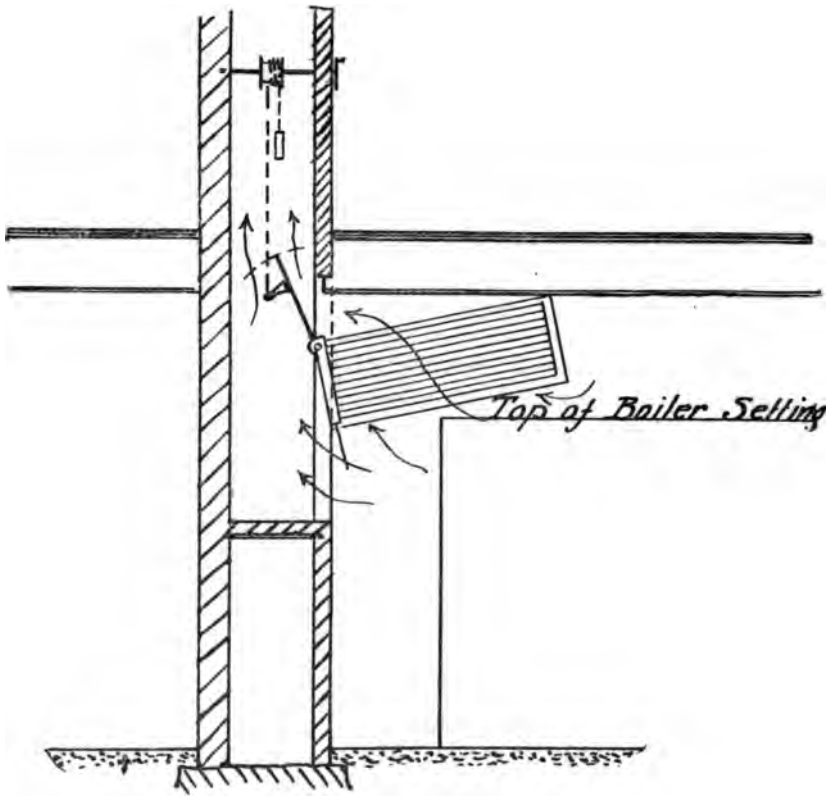
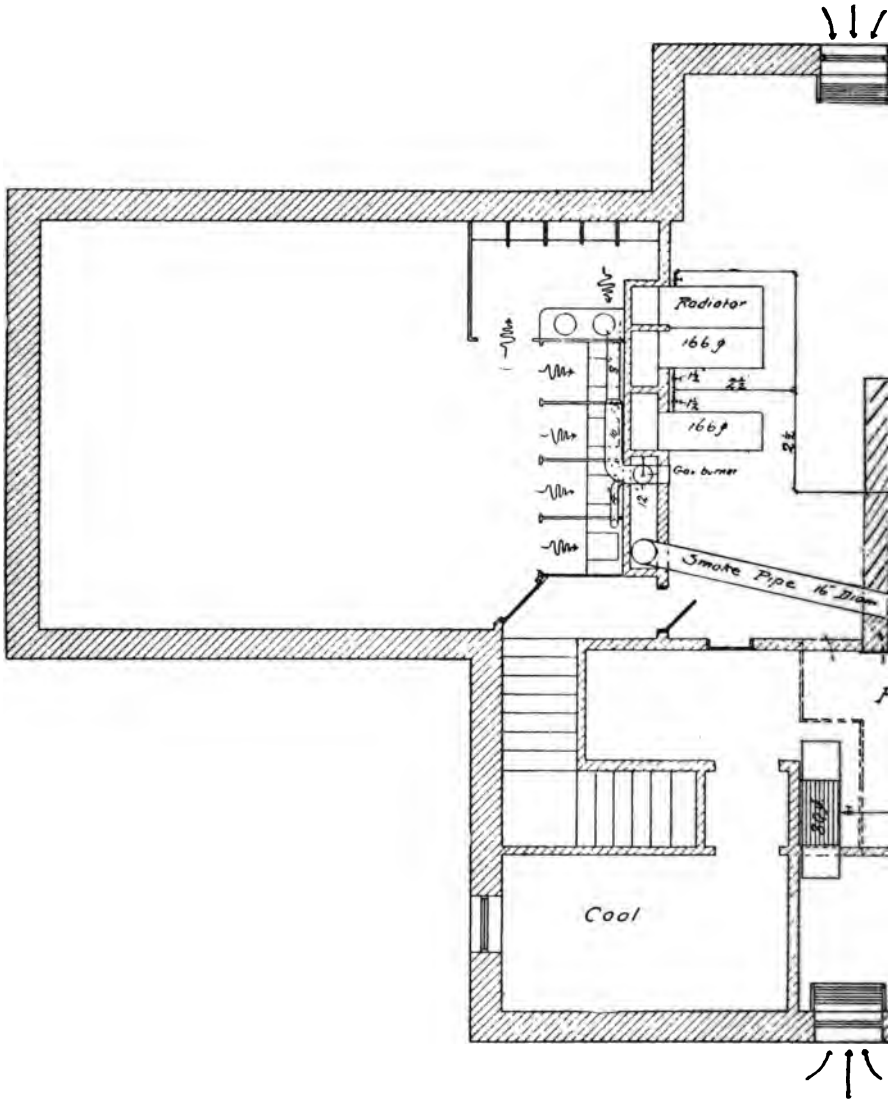
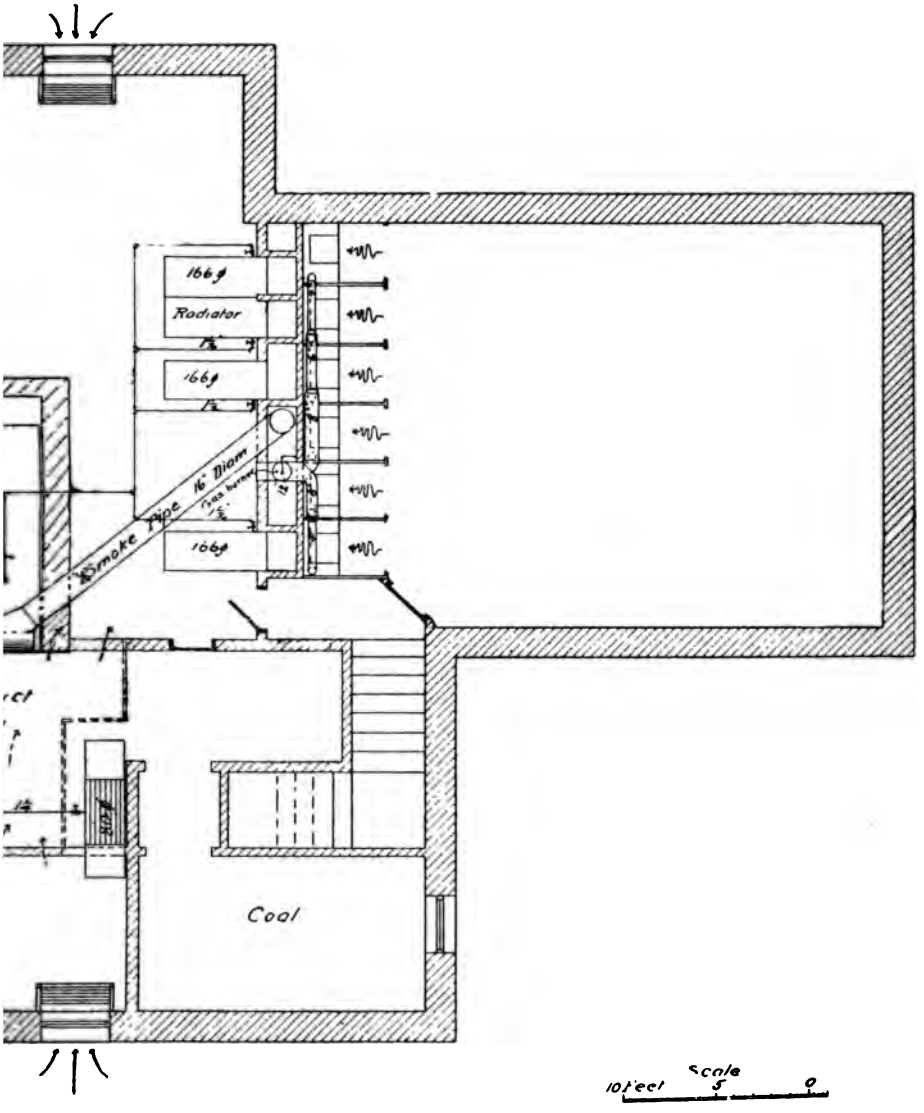


FIG. 37.


Radiator
166 ƒ
166 ƒ
Gas burner
Smoke Pipe 16" Diam
Cool


166 ft
Radiator
166 ft
Smoke Pipe 16" Diam
Gas burner
166 ft
Coal
Scale
10 feet
5
0

The water-closets are shown vented through independent pipes extending to and through the roof, and connected with the seats for the purpose of effecting a strong local ventilation. See Group II, Figure 45. At the bottom of these pipes should be placed a gas burner of twelve cubic feet capacity. See Group II, Figure 42. Gas is recommended rather than steam, because ventilation of the room is most needed when steam is least required for heating the building.

If the basement rooms are to be used for recreation purposes, they may be ventilated during recess time by connecting them with the vent shafts used by the rooms immediately above them. These four discharge flues may, by means of proper connections and switch valves, be made to ventilate the play-room during recess and the schoolrooms during school sessions. The supply air at such times could in cold weather

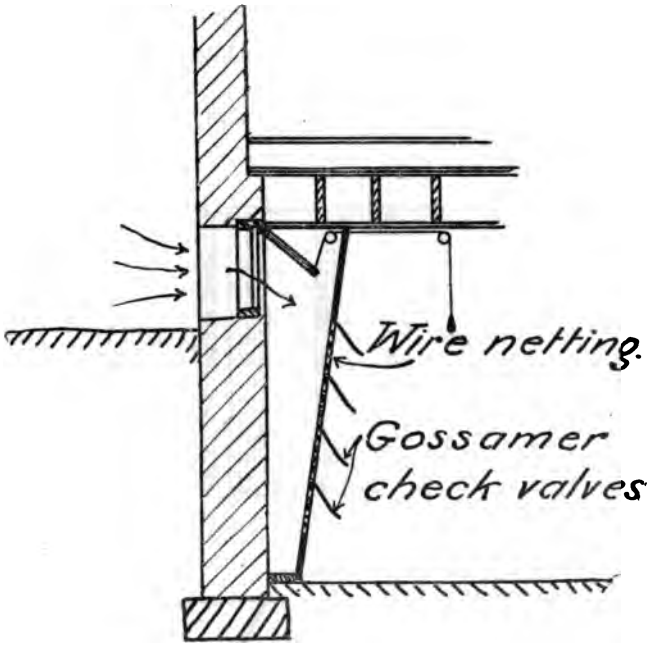


FIG. 38.

be obtained from the halls through the stairways, and in mild weather from out of doors through the windows.

Figure 39. For the movement of air from the halls into the schoolrooms, the doors should be furnished with transoms.

To allow the air to pass into the wardrobes from the schoolrooms, the lower panels of the doors should be open slat work or coarse wire netting.

To effect successive ventilation and to prevent the too direct escape of hall air, the doors from the halls into the wardrobes should be self-closing.

If it is not desired to provide means for shutting air off from some rooms while not in use, the diffusers at the inlets may be backed by coarse wire netting, not finer than one fourth inch mesh, instead of registers with valves. For the setting of diffusers and gratings, wooden frames of at least one inch stock and suitable width should be set into the brickwork. The gratings which carry check valves should be held in place by screws for easy removal when adjustment or repair of the checks may be required.

Figure 41. On this plan is shown an arrangement of vent duct piping in the attic.

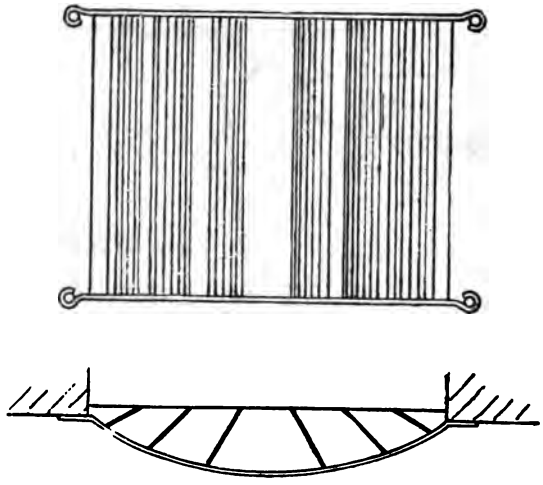
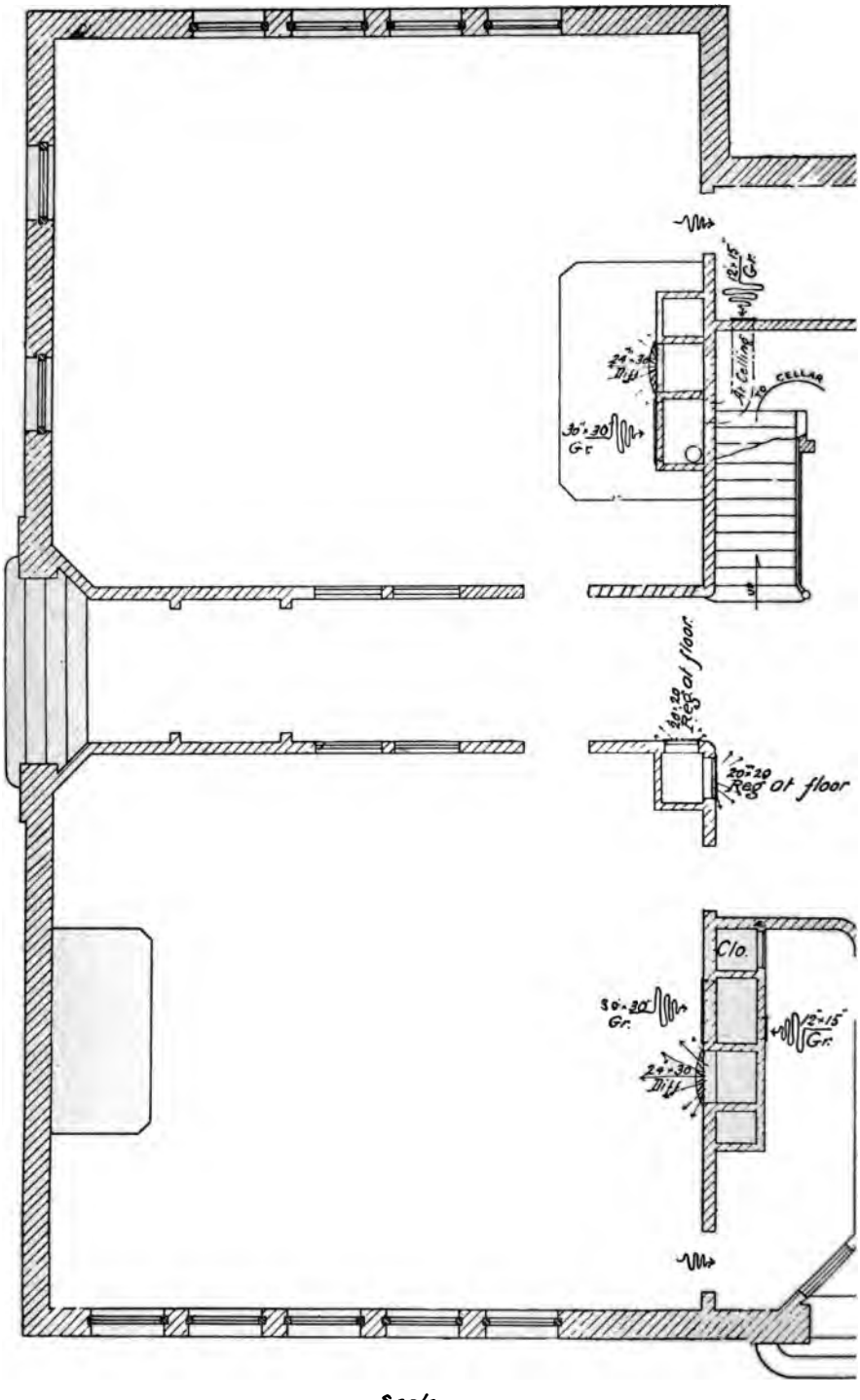
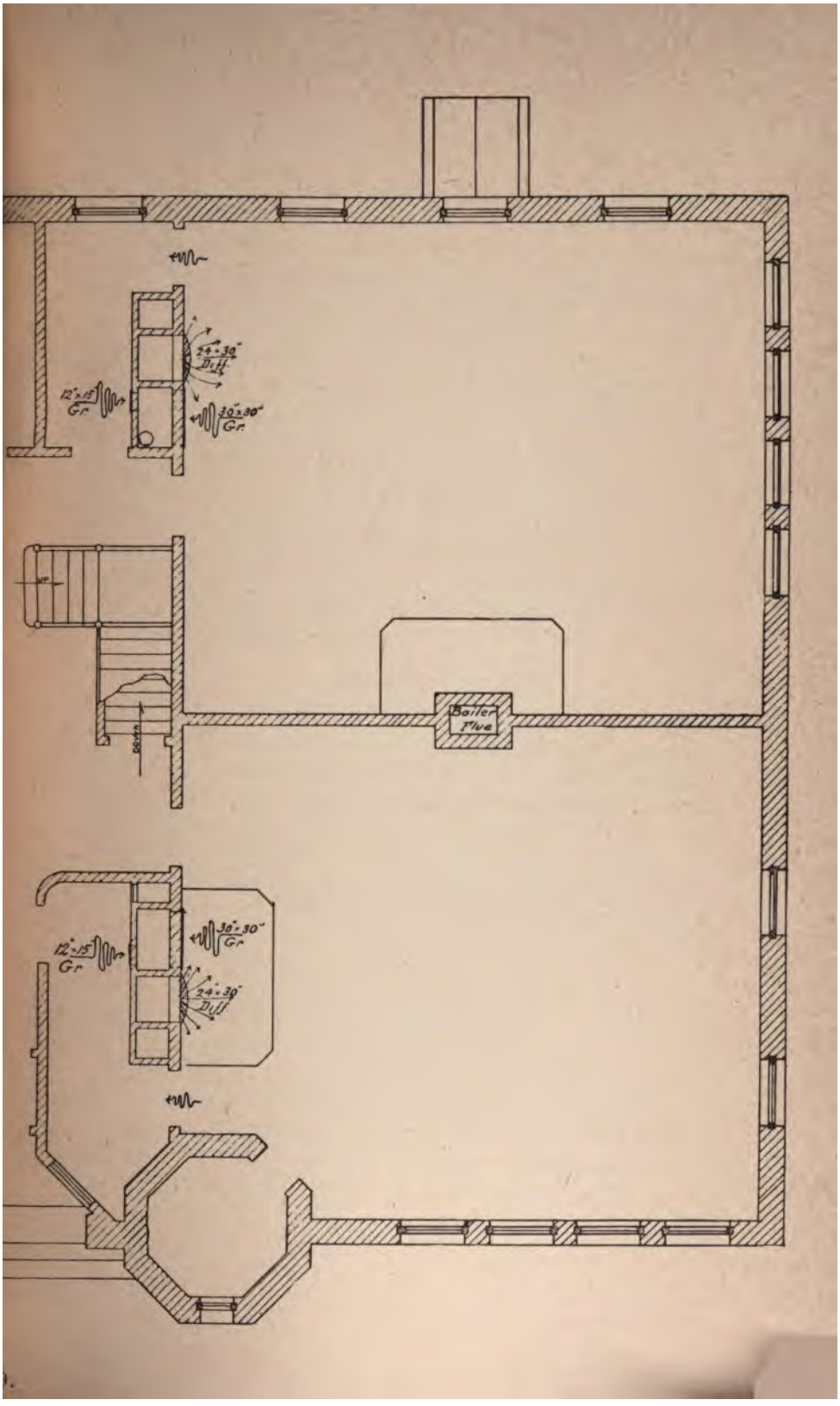


FIG. 40. — DIFFUSERS.



Scale
10 Feet. 5 0


24 x 30"
Diff
12" x 15"
Gr
30" x 30"
Gr
Boiler
Flue
12" x 15"
Gr
30" x 30"
Gr
24 x 30"
Diff

The four vent flues might be carried out through the roof separately. In that case their tops should be built up above the ridge of the roof, and the central tower, shown on the furnished plans, should not be built, as its presence would endanger the action of the flues in windy weather. If the flues are carried directly out, dampers should be placed in each of them.

The damper or dampers should be made controllable by chains from the floor below, and should be provided with suitable arrangements for adjusting and holding them in any desired position. The principal use of such dampers is to control the rate of flow of air from the rooms. They also serve the purpose of preventing excessive chilling of the flues when the ventilation is not in progress, as at night. If dampers are not used, check valves placed on the vent gratings will prevent the reversal of flow and consequent chilling of rooms. They cannot regulate air flow.

GROUP II.

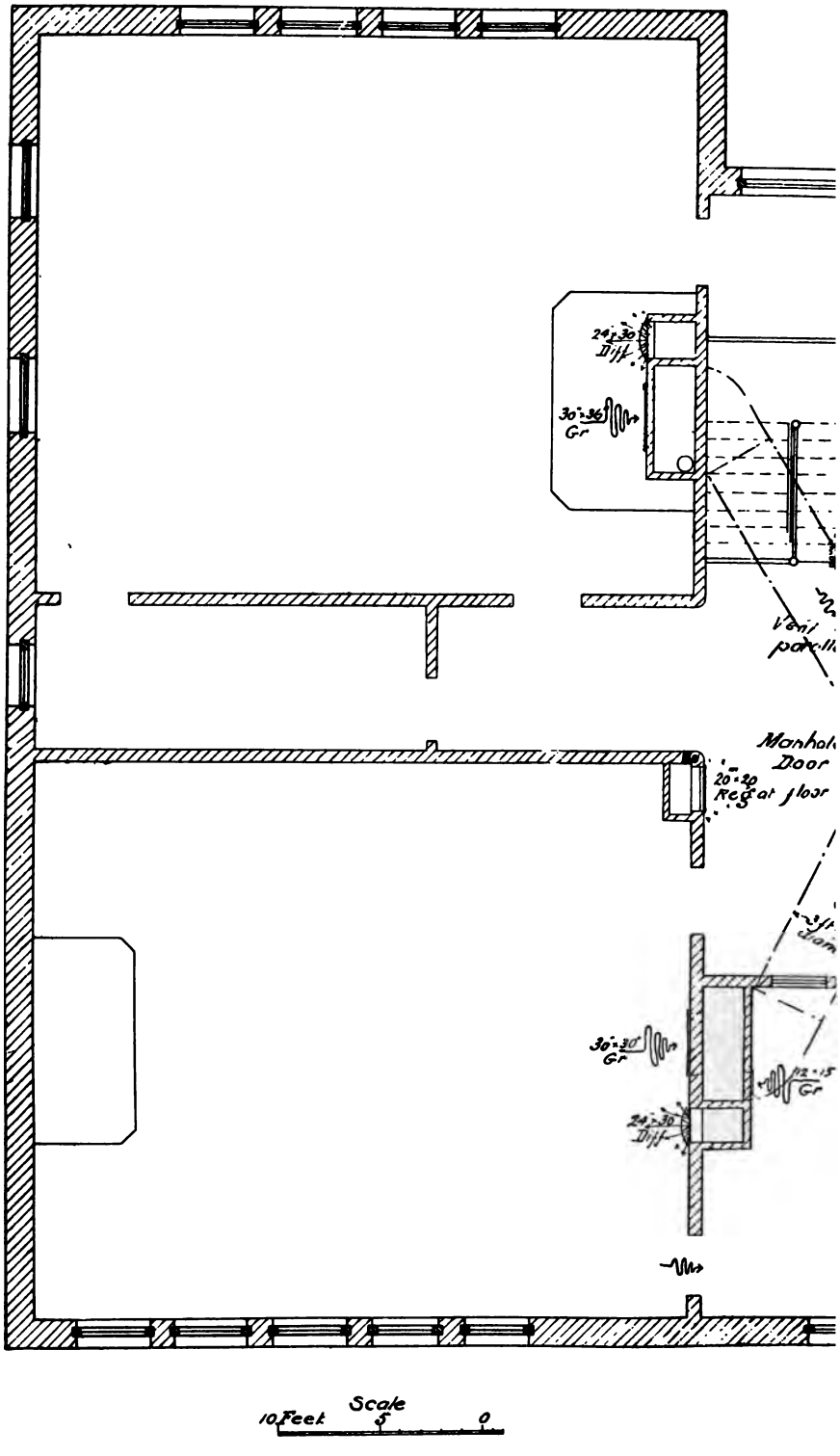
Figure 42. The same general arrangements appear in this plan as in Figure 36 of Group I. The fresh air inlets are upon two sides of the building, and the fresh air chamber extends through the building, occupying the middle part of the basement. The boilers and the smoke and steam pipes are within this chamber, as also the fire-room, the ceiling of which is dropped two feet below the air chamber ceiling to form a connecting duct between the front and the rear parts of the chamber. The dotted lines show the position of the fire-room walls, these being carried to the air chamber ceiling, as also the two ends of the transverse wall which are outside the limits of the air duct. These partitions may be made of one and one half inch boards tinned on the fire-room side.

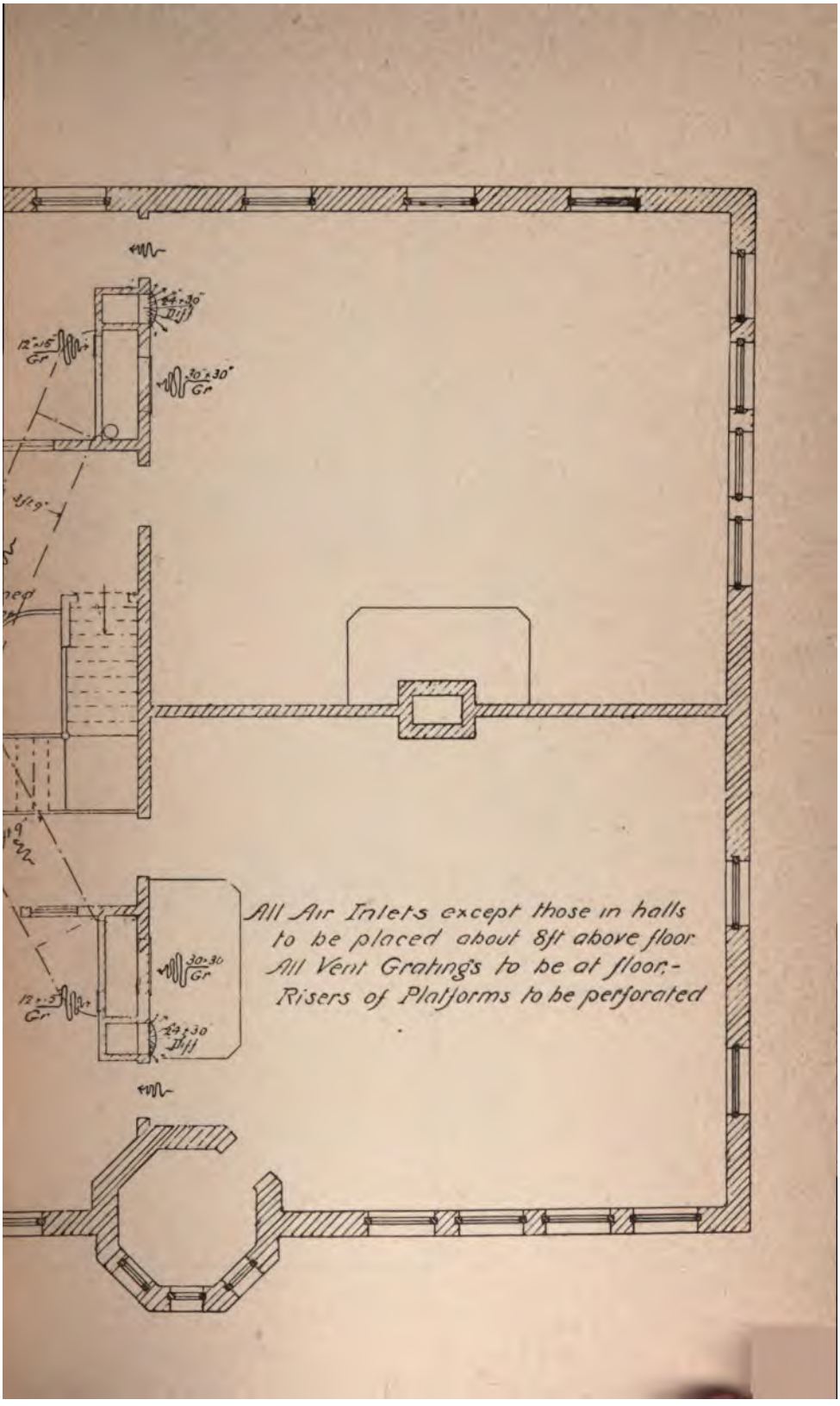
For the rotation of air, for warming the building before it is occupied for school work, doors are placed at the entrance to the play-rooms, which in the plan are shown to contain the closets. The play-rooms are in this case practically sanitary rooms, and, even for purposes of warming the building, it is

not desirable that the circulating air should be allowed an entrance into them and an after return to the building. The two doors at the foot of the stairs should be closed at such times, but at all other times they may be swung back against the closet partitions, to which they are hinged, these particular partitions extending to the ceiling for the purpose of making a tight dividing wall between the sanitary rooms and the other parts of the building.

Figure 43 shows four floor registers in the hallway and the arrangement is sketched as offering an alternative plan with that described under Group 1, for hall warming. Exposed hot radiators in a passageway, liable at any time to be crowded, are not advisable. On the score of personal safety, unobstructed floor space, and effectiveness in warming and drying clothing, it is better to place such radiators under the floors and connect them with registers as shown in Figure 44.

Figure 45 represents the method recommended for the ventilation of the water-closets. The aim is to secure a continuous downward flow of air in large volume through the seat. The air vents with which the basins or "closets" are furnished are generally quite inadequate, their area being seldom more than from two to three square inches. The figure shows the basin under a hinged cover, or seat, which extends from wall to wall of the closet. The riser is also hinged at the bottom. By raising the seat and dropping the riser, the basin and its fittings can be as much exposed as if the basin were adjusted for use without such covering. The clear space between the under surface of the seat and the top of the basin should be at least one half inch wide. As a closet, the Boston short hopper is recommended rather than the type shown, a cut of which is not available at the moment for the sketch. The floors should be asphalted; the bottom of partitions and of doors should not reach the floor by from four to six inches, and doors should swing inward and be held open by a spring except when in use.


24"x30"
Diff
30"x36"
Gr
Manhol
Door
20"x20"
Reg at floor
30"x30"
Gr
12"x15"
Gr
24"x30"
Diff
Scale
10 Feet
5
0


All Air Inlets except those in halls
to be placed about 8ft above floor
All Vent Gratings to be at floor.-
Risers of Platforms to be perforated

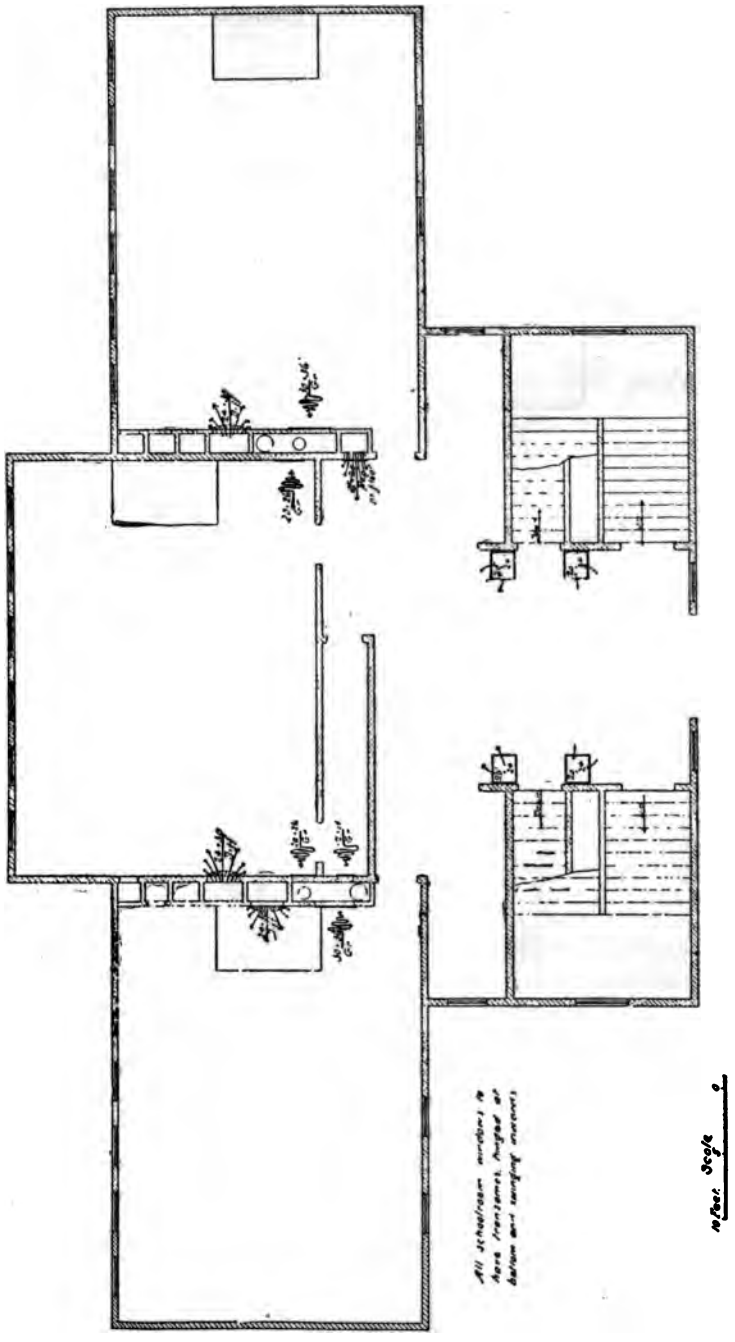


FIG. 43.

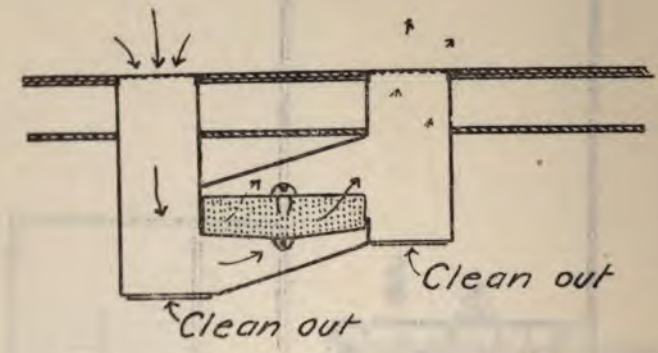


FIG. 44.

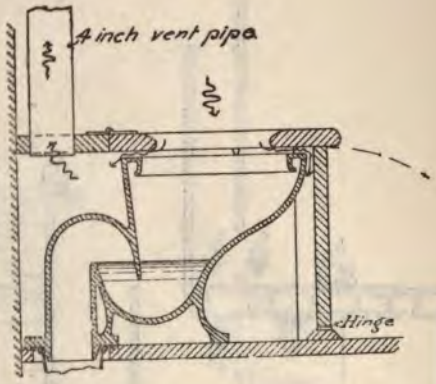


FIG. 45.

Figure 46 shows the method of attaching the gossamer check valves to the vent gratings. They should be made of the lightest rubber gossamer. The strips should not be more than six inches in width, secured at the top to a light piece of wood one fourth inch thick and one half inch wide, or to a small and straight wire. The strip should be so hung that

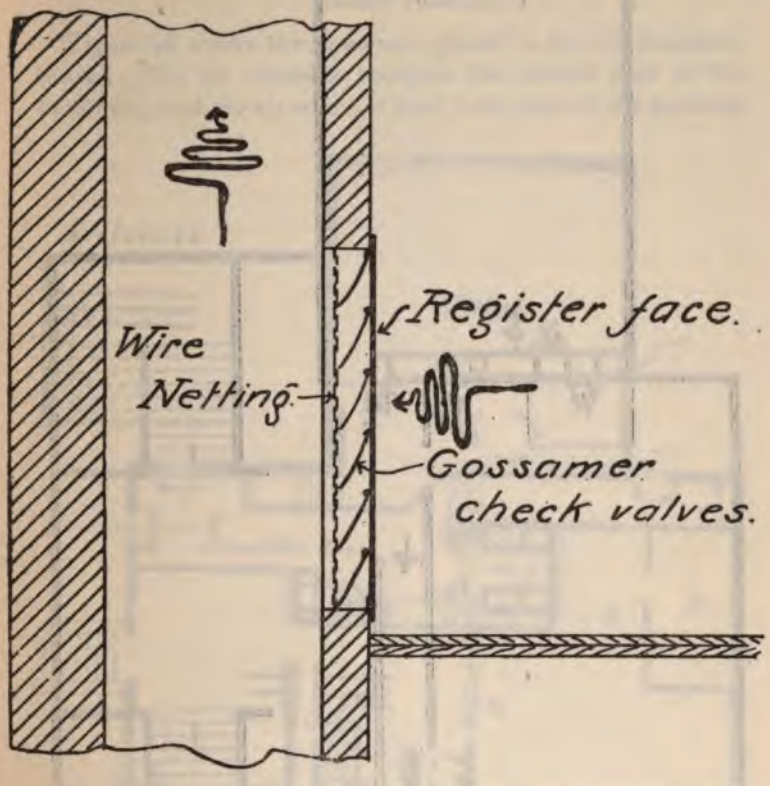


FIG. 46.

the bottom of one laps over the top of the one next below by one half inch, and the ends of the strips should be so secured that when in use the gossamer shall not draw away from the ends and gather in the middle. The wooden strips or wire rods carrying the gossamer cloth may be wired to the face, which should be secured by screws into a wooden frame set for the purpose. Should the draught prove strong enough to cause noise by the flapping of the check valves, coarse wire netting may be placed behind the register face and valves, as shown in the figure.

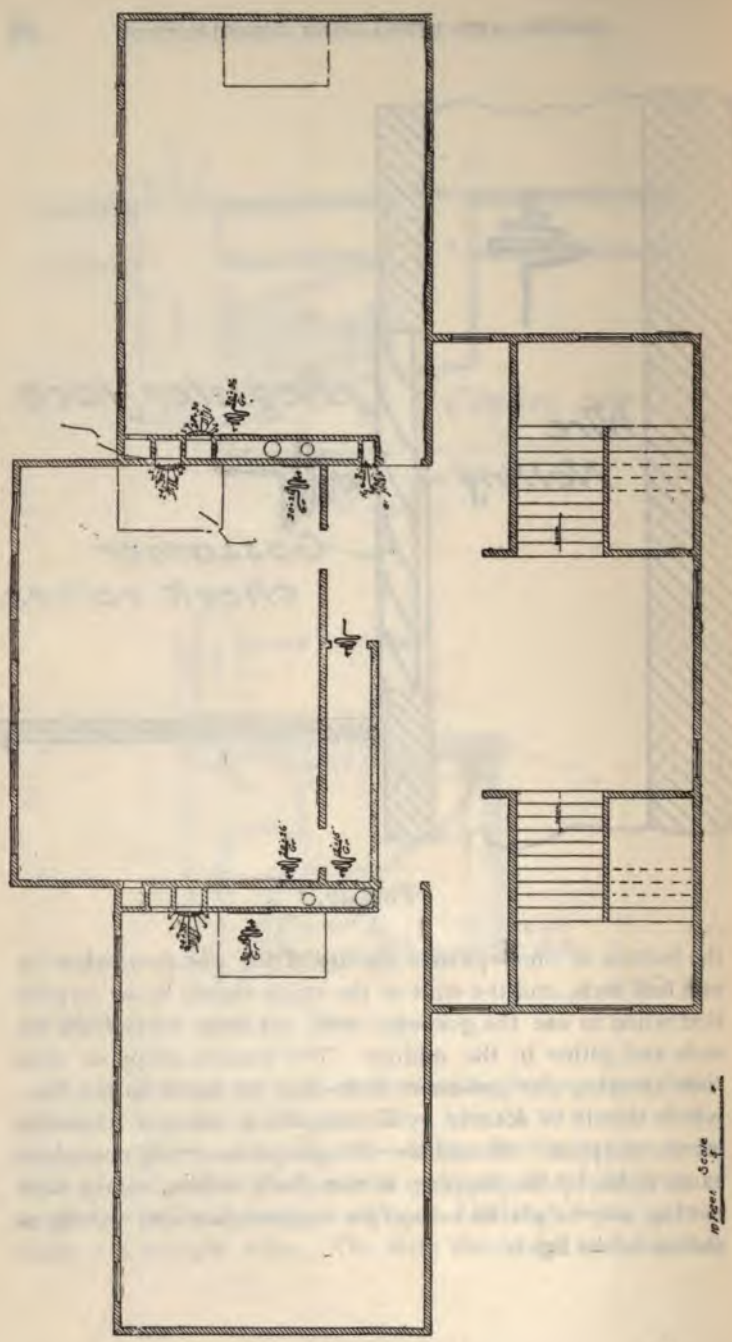


FIG. 47.

GROUP III.*

Figure 48 shows the basement plan of a four-room schoolhouse. The air chamber occupies the central part of the basement, and the air enters it from both sides of the building

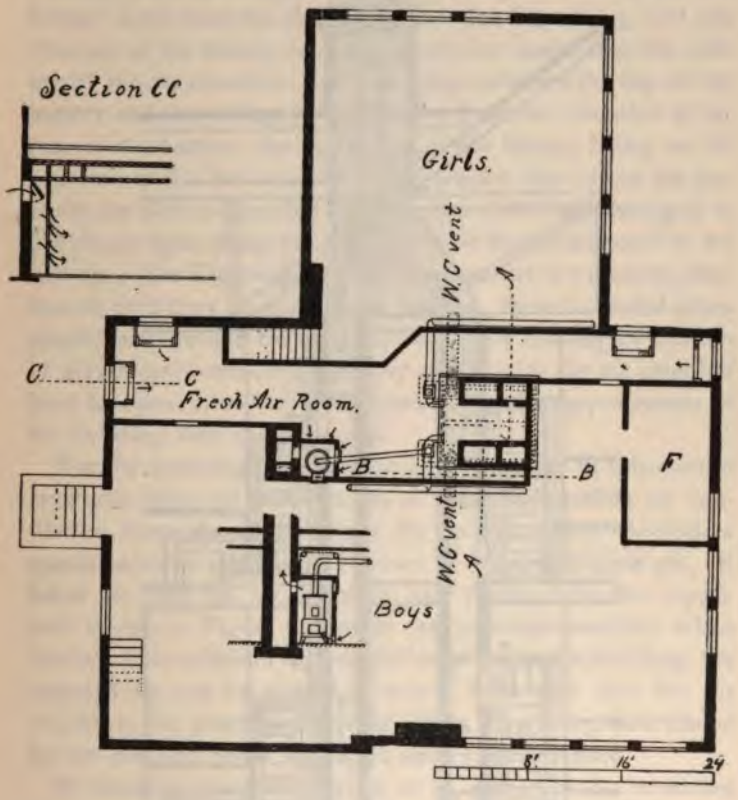


FIG. 48.

*The draughtsman made several errors in the drawings for the figures under Group III. In Figure 49 the stippling indicative of the foul air flue at the left should have been carried down to and below the vent opening.

In Figure 51 the two upper arrows in Section B. B. should have been placed at the vent openings above them and the baffling should be just below the vent openings.

In Figure 52 and 53 the construction of the flues between the wardrobes (G. W. and B. W.) is wrong and the direction of the arrows should be reversed.

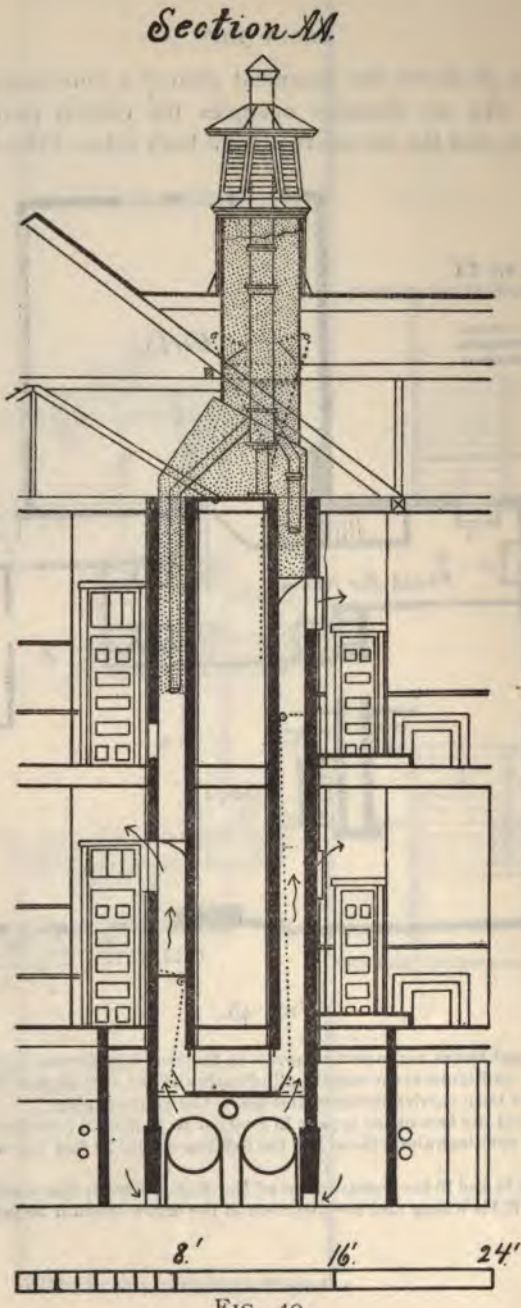


FIG. 49.

through valved inlets. The air is warmed by a battery of two Gold's Hygienic Heaters placed between the main walls of the corridor. The walls of the air chamber are so run as to convey air to both sides of the battery, into which it enters through a series of openings ranged along the base of the two battery walls next the air chamber. See Figures 49 and 50. The top of the battery housing is two feet lower than the ceiling of the air chamber, and the space between the top of the battery and the ceiling is open to the fresh air chamber at the rear of the battery, the fire doors of the battery being at the end toward the fuel room F. The smoke pipes from the furnaces are shown extended into the play-rooms and arranged in trombone form along the walls of those rooms adjacent to the battery. See Figure 49. If these rooms are not used as play-rooms, or if they do not require heating, these extended pipes should be placed in the air chamber. For heating by rotation of air, doors connecting the play-rooms with the air chamber may be opened, as also those connecting the upper rooms of the building with the basement.

For the warming of the wardrobes which are in this case so separated from the schoolrooms as to be inaccessible for ventilation from the schoolrooms by the successive method, a special stove is provided, as shown in detail in Figure 48. It takes air from the air chamber, and passes it to the supply duct shown in Figure 51; or in case of severe weather, when the heat is insufficient for ventilation of the entire building, the warmed air may be passed in whole or in part into the air chamber, the quantities moving either way being determined by the position given the valves shown in the figure.

If sanitary conveniencies are to be placed in the basement they may be vented through ducts run through the main shafts and heated by gas flames. The closets should then be so arranged as to admit of successive ventilation by taking warmed air from the play-rooms, to which fresh air may be admitted either through windows or from the furnace and air chamber as circumstances may require or conditions favor.

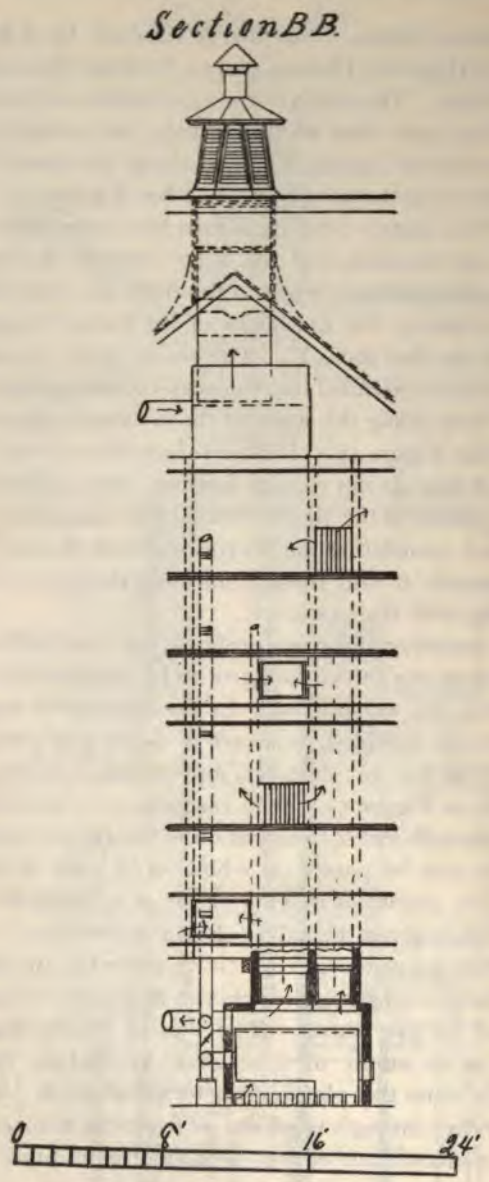


FIG. 50.

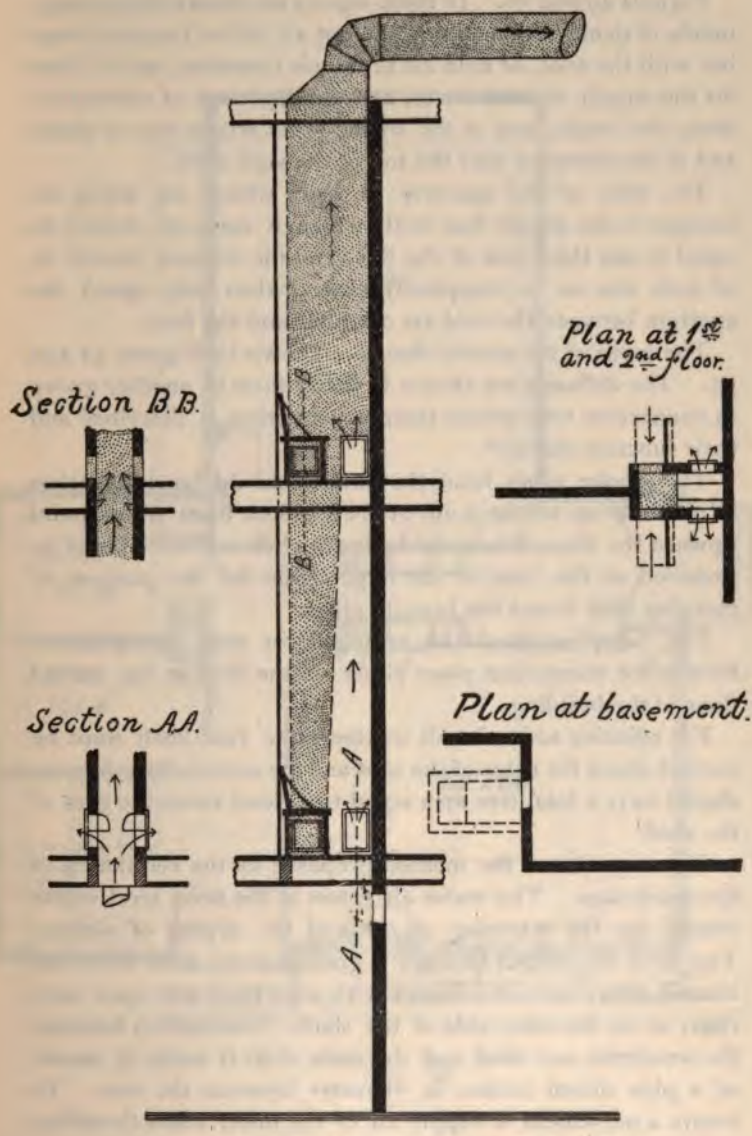

Plan at 1st and 2nd floor.
Section B.B.
Section A.A.
Plan at basement.

FIG. 51.

Figures 49 and 50. In these figures are shown the arrangements of dampers for mixing the hot air of the furnace chamber with the cool, or cold air of the air chamber, and of flues for the supply of fresh air to, and the discharge of vitiated air from, the rooms, and of the smoke pipes within the air shafts and of the dampers near the top of the vent shaft.

The area of the aperture through which the warm air escapes to the supply flue with which it connects should be equal to one third that of the flue, and the damper should be of such size as to completely close (when fully open) the aperture between the cold air chamber and the flue.

The areas of the several flues are shown in Figures 52 and 53. The diffusers are shown in better form in another group in connection with which their construction is described and their function stated.*

The smoke pipes from the furnace should be eight inches in diameter up to the point of their union, from which point upward the diameter should be ten inches. Doors should be provided at the base of the larger pipe for the purpose of cleaning both it and the branch pipes.

The dampers should be arranged for easy manipulation from some convenient place either on the first or the second floor of the building.

For effective action in all weathers the vent shaft must be carried above the ridge of the roof and the surmounting louvres should have a total free area equal to at least twice the area of the shaft.

Figure 51 shows the method proposed for the ventilation of the wardrobes. The warm air enters at the floor level where wanted for the warming of feet and the drying of clothes. The air is discharged through a grating at the same level and located either beneath a bench with solid front and open back riser, or on the other side of the shaft. Connection between the wardrobe vent shaft and the main shaft is made by means of a pipe fifteen inches in diameter between the two. To insure a movement of supply air to the lower room throttling and baffling plates are placed in the shaft as shown in Section AA.

* See page 41 and Figure 40.

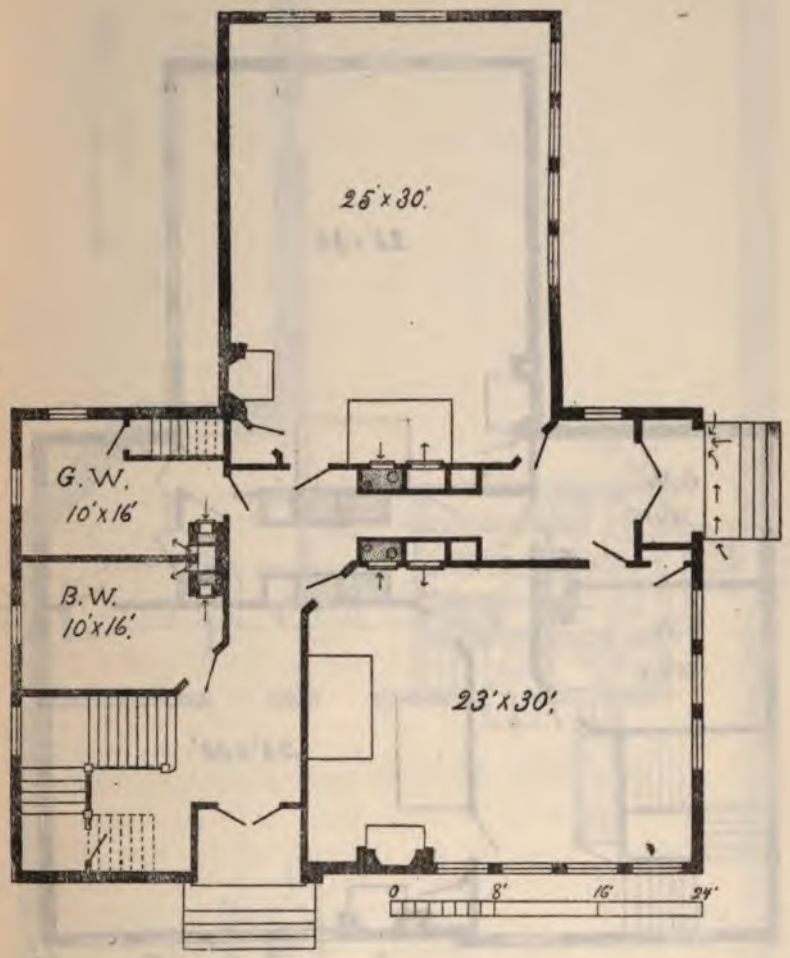


FIG. 52.

Figures 52 and 53 indicate the arrangement of rooms on the first and second floors of the building.

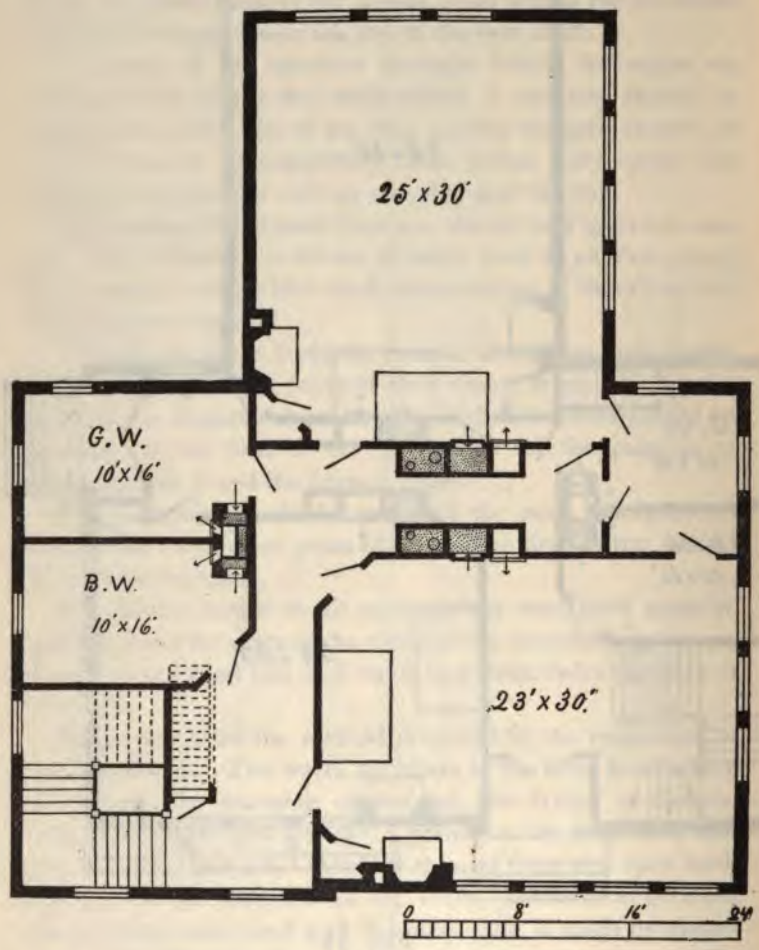


FIG. 53.

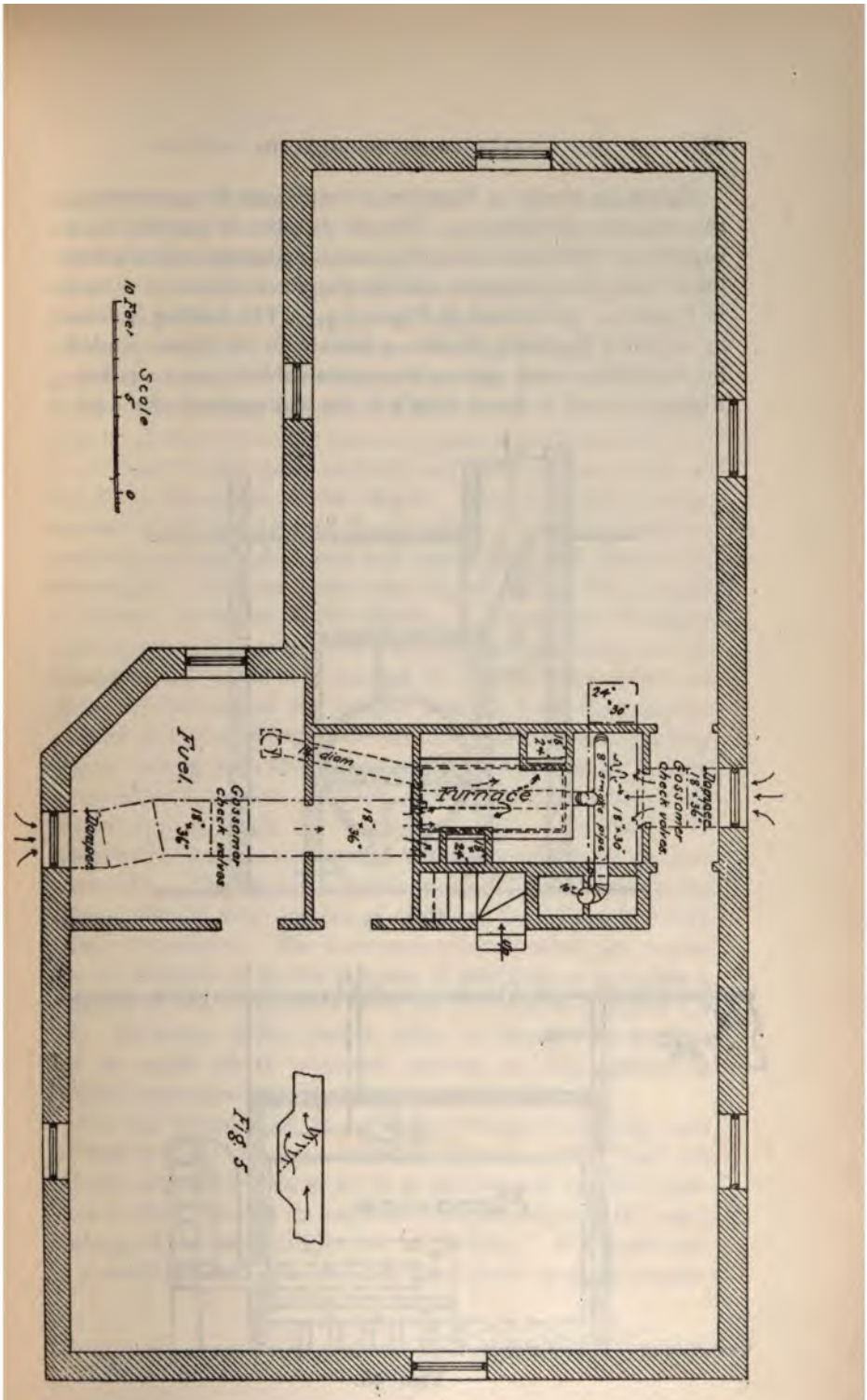


FIG. 54.

Figure 54 shows a basement arrangement for a one-story, two-roomed schoolhouse. The air chamber is reached by a supply duct from each side of the house. At a convenient point these ducts are enlarged to receive the check valves, as shown in Figure 5. (Included in Figure 54.) The heating is done by a Gold's Hygienic Heater, a furnace to be recommended for ventilating work among those obtainable in open market. Figures 55 and 56 show details in the arrangement of the set-

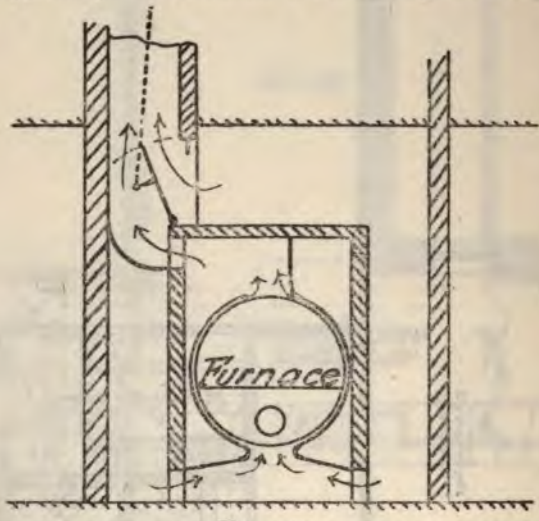


FIG. 55.

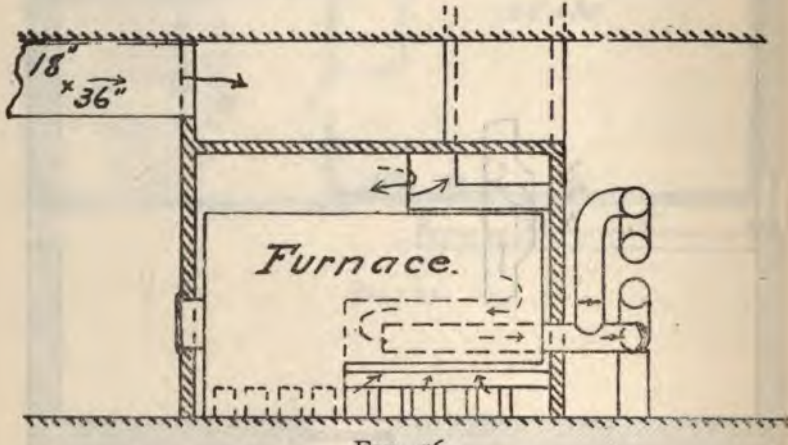


FIG. 56.

ting for these furnaces. The furnace should have a grate area of at least five square feet for use in the colder parts of the State, for which the heating power of all the apparatus shown or described in this paper has been proportioned. The furnace shell may be extended as required by the addition of sections. Inside of the furnace the maker should place a guard to prevent the throwing of coal into and the accumulation of ashes within the drum of the furnace. There should also be placed within the furnace a plate of such form and size as to cause the hot gases to reach and heat the lower part of the drum through its entire length. Also, to insure a better contact of cold air with the furnace shell, it would be well to partially surround the shell and its flanges with sheet iron, separating it from the outer edge of the flanges by a couple of inches, as shown in the figure. To cause air of nearly equal temperature to be delivered through the ducts, one in front and one in the rear parts of the furnace, the sheet iron jacket on that side of the furnace next the front duct may be carried up to the ceiling of the furnace housing, so compelling the air issuing from about the front and hot part of the furnace to travel well toward the back end of the hot air chamber before it can reach the front flue. The air should be admitted to the furnace through the whole extent of the furnace wall. The openings for the escape of warm air from the furnace should have an area of one third that of the flue with which it connects. The extension of the smoke pipe within the air chamber is for the purpose of effecting as complete a transfer of heat as possible from the combustion gases to the air. By means of the switch valve or damper, the draught can be made direct whenever desired, an essential to all similar arrangements described.

For the warming of the halls and drying of clothing, connection is made as shown, with the furnace. The slight ascensive force of the warm air in so short a rise, and the resistance to flow through so long and comparatively small a duct endangers the desired direction of air flow. A separate fire in a small jacketed stove beneath the register, and the connec-

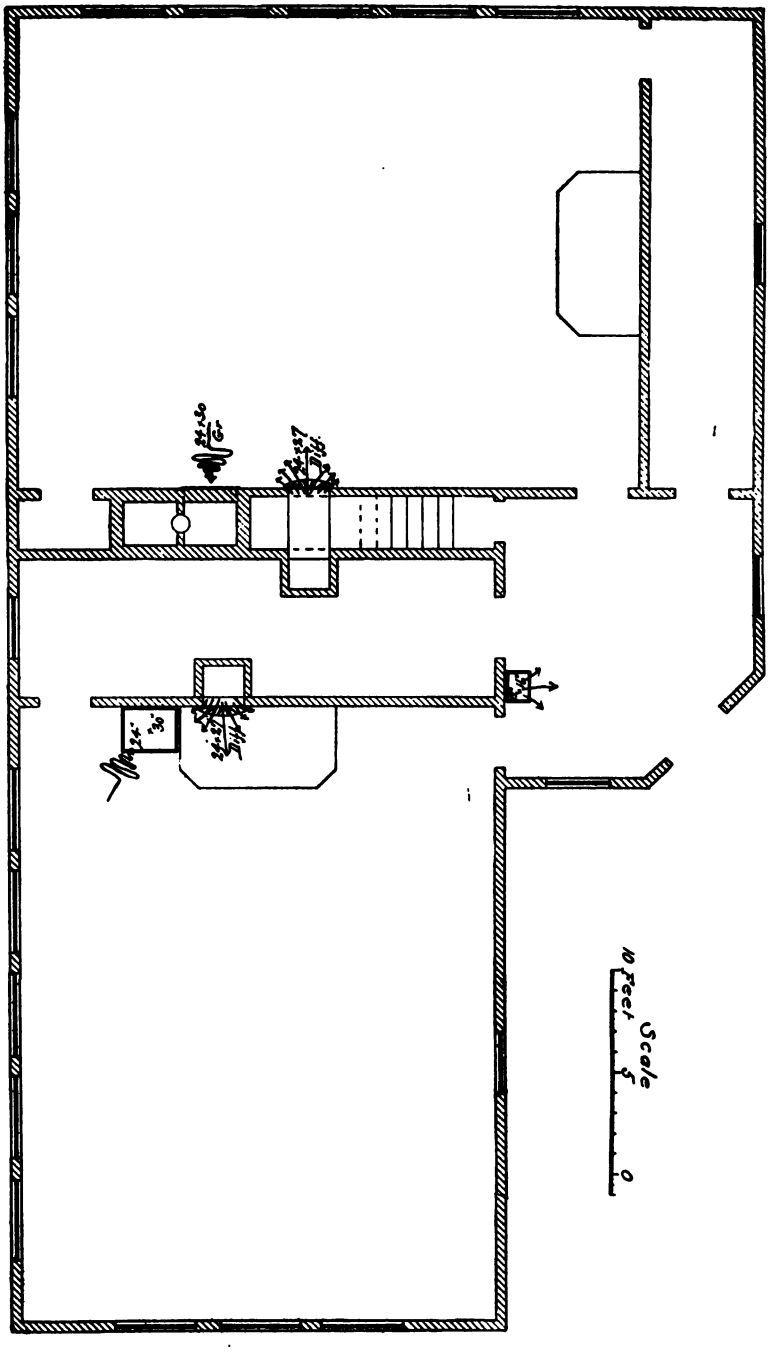
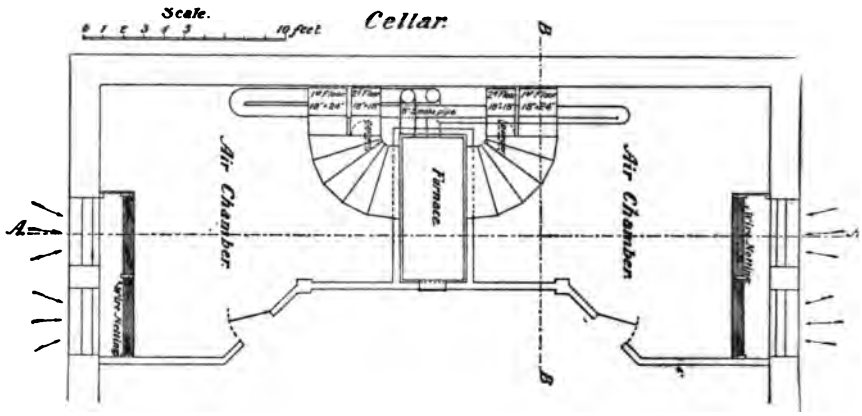


FIG. 57.

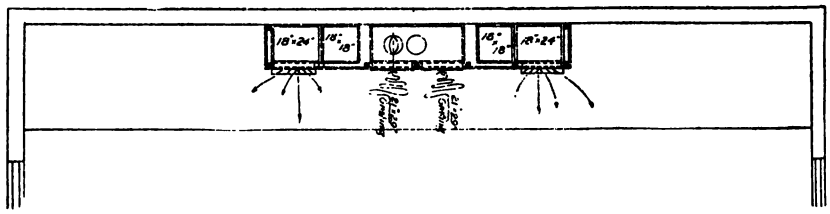
tion of the lower part of the jacketed chamber with the hallway by means of a ten-inch pipe would insure a flow of warm air into the hall. This method is to be recommended in all cases in which ventilation of halls or wardrobes is not desired. In severe weather, the stove could be used as an auxiliary to the furnace. The discharge flues from the rooms should be carried above the highest part of the roof by at least one or two feet, and generally higher.

GROUP V.

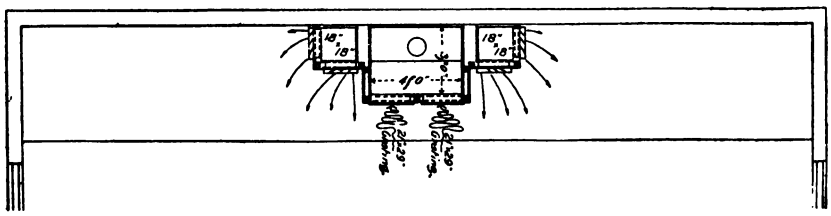
The figures in this group illustrate a method of ventilating a two-storied, two-roomed schoolhouse. The internal arrangements are such that the apparatus must be located at the rear of the building and of the schoolrooms. The end of the basement is partitioned off by a wall and the enclosure is made the air chamber. In this chamber the furnace is placed, the two parts of the chamber being connected by the space between the rear of the furnace and the wall of the building, and that between the top of the furnace housing and the air chamber ceiling. These connecting spaces are clearly shown in Figure 63. The heated air is conducted to the flues by means of a curved and flat iron pipe, the sectional area of which is one third that of the flues with which it connects. See Figure 51. Dampers are placed in the branches of these ducts to effect the desired division in the air quantity flowing to the flues. They are shown in the two inner branches only, but the other branches require them equally, for the reason that the outer flues receive the hotter air escaping from the front part of the furnace, while the inner flues being the taller, have the stronger draught. The varying conditions cannot be met as surely by a single adjustment made once for all, as by trial and occasional readjustment as conditions require. The general arrangement of mixing dampers, trombone extension of the smoke pipe, valved inlet windows, doors to air chamber for warming by rotation, are shown in Figures 58, 60, and 63.



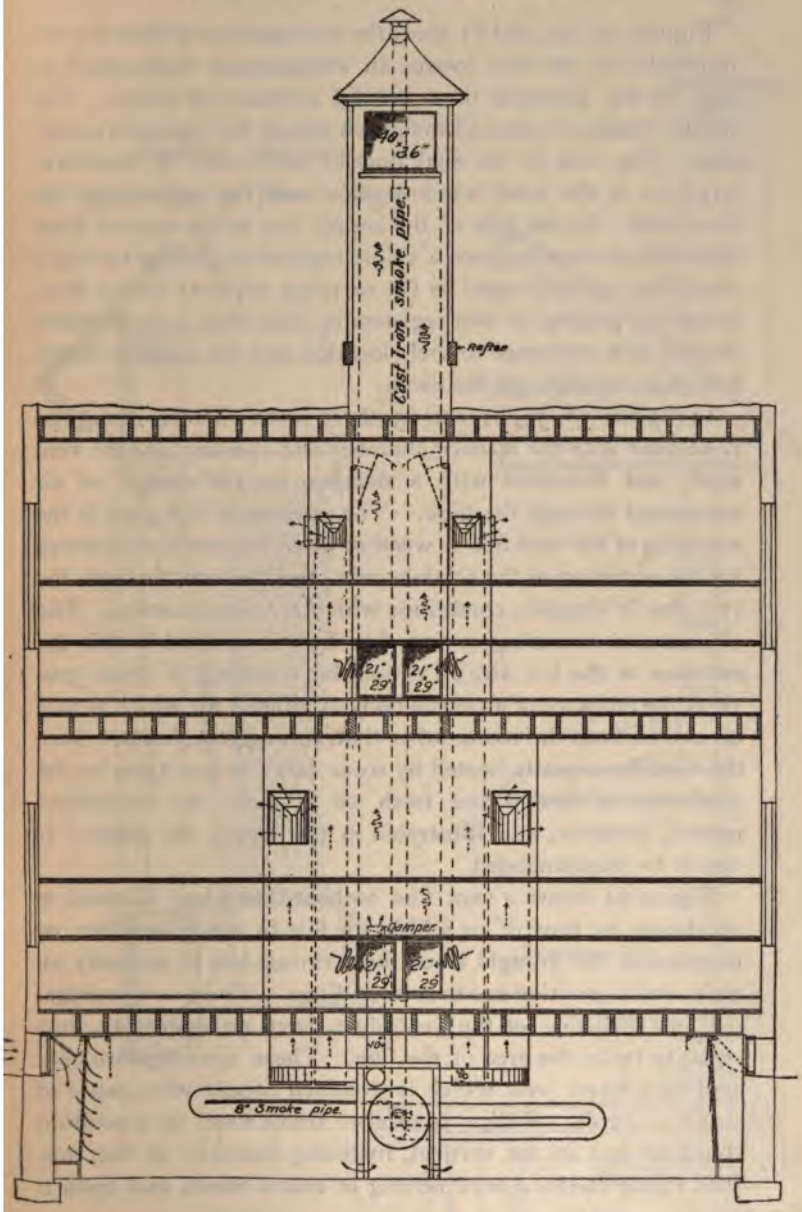
First Floor.



Second Floor.



FIGURES 58, 59, and 60.



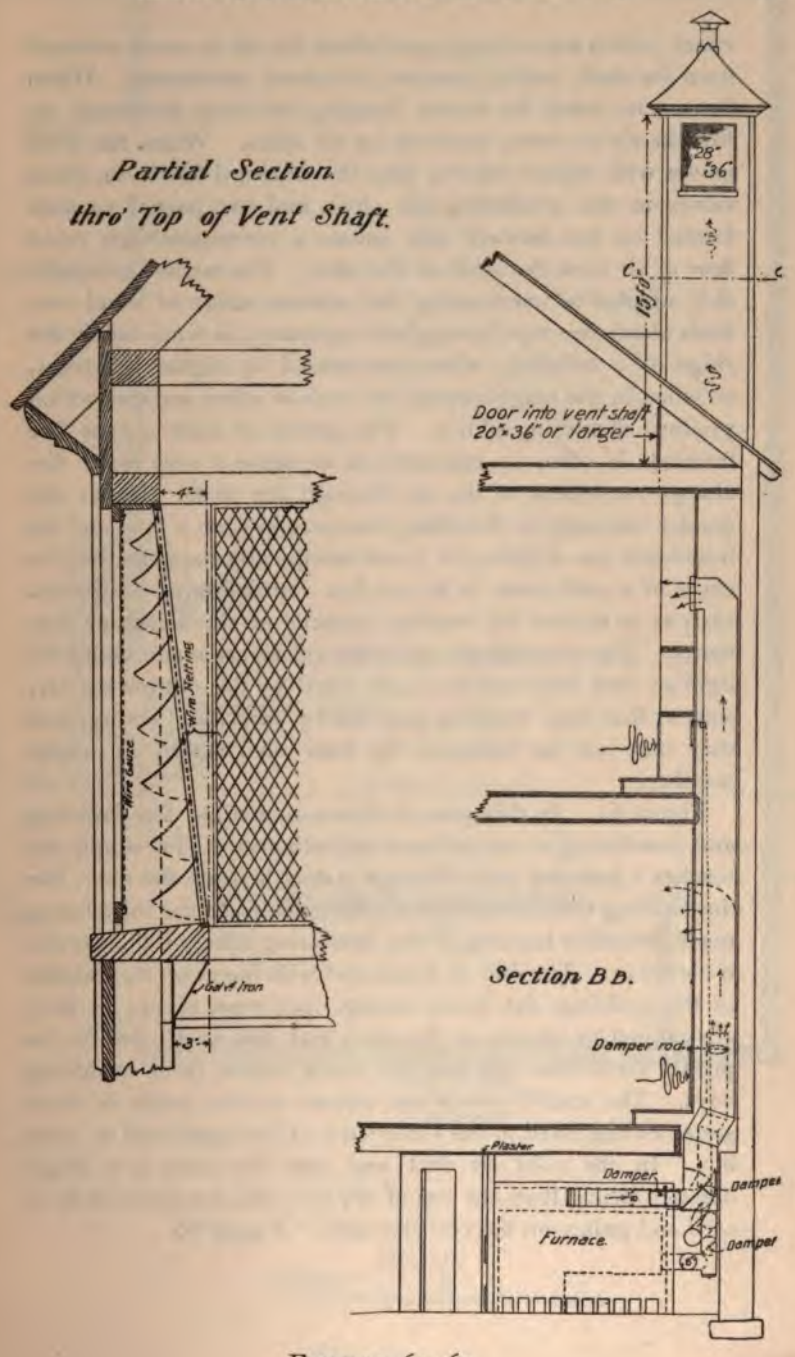
Section AA.

FIG. 61.

Figures 59, 60, and 61 show the arrangement of flues for the ventilation of the two rooms, an arrangement determined in part by the presence of a central chimney of brick. The whole system is planned to furnish means for copious ventilation. The area of the dual duct to each room is, therefore, large, as is the inlet window area, and the capacity of the vent shaft. In the side of the supply flue to the second floor there is not room to place a single register or grating having a discharge capacity equal to the carrying capacity of the flue; hence the placing of two registers in each flue, with diffusers shaped with reference to their location and the equable distribution of air through the room.

In Figures 58, 59, 61, and 63, there is shown a ten-inch pipe connected with the furnace chamber and opening into the vent shaft, and furnished with a damper for the control of air movement through the pipe. The purpose of this pipe is the warming of the vent flue in weather when the heat is not wanted for the warming of the schoolrooms, and the flow through the vent flue is sluggish, conditions which are simultaneous. The objection to warming a vent flue by this method is that the entrance of the hot air, by which the warming is done, prevents the entrance of an equal body of vitiated air which would be moved from the room rather than through the furnace were the vent flue equally heated by some other means than by the admission of heated and fresh air. Under the conditions named, however, and illustrated in the figure, the method is one to be recommended.

Figure 62 shows a vent flue outboard terminal adapted to accelerate the flow of air within the flue in windy weather, or to maintain the draught when the terminal has of necessity an unfavorable position due to surroundings. The four openings, one on each side of the vent duct, have an aggregate area equal to twice the area of the flue. These openings are covered by a frame over which is stretched copper wire gauze of about $\frac{1}{8}''$ mesh. Within is another frame fixed in a position about 10° out of the vertical, inclining outward at the top. This frame carries a wire netting of coarse mesh, and upon it



FIGURES 62, 63.

check valves are so hung as to allow the air to move outward from the shaft, and to prevent its inward movement. When there is no wind, the valves, hanging free from the frame, allow the air to move outward on all sides. When the wind moves with higher velocity than the outward flow rate, those valves on the windward side close, and the partial vacuum formed on the leeward side causes a correspondingly rapid flow of air from the shaft on that side. The method is admirably adapted to overcoming the adverse action of wind currents about flue tops having bad exposures, as when below the ridge of a building, when surrounded by higher buildings, or when in the neighborhood of roofs or other surfaces which produce disturbing eddies. The action of such a vent flue terminal is often so energetic as to cause a very rapid discharge movement of the air through the shaft. Hence the greater necessity of throttling dampers in such a flue, and an intelligent use of them, for it not infrequently happens that the cause of a cold room is its too free ventilation, a ventilation such as to exceed the heating capacity of the boilers or furnaces. The material of which the valves are made should be light so that they may be easily lifted by the outflowing air, soft, so that their flapping may not be noisy, and strong, that they may not be destroyed by their own action in windy weather.

Figure 64. In this plan is shown a method for warming and ventilating a one-roomed schoolhouse. The supply air reaches a jacketed stove through a duct beneath the floor, the duct having three connections with outside air, the third being made advisable because of the interfering effect of the porch, if closed in. The duct is connected with boxes on the outside of the building, the boxes having open tops, except as they are capped as shown in the plan, and also in Figure 65, to protect them from rain and the check valves from meddling boys. The check valves are placed on the inside of wire gauze frames fixed to the three sides of the upper end of each box. In the cold air duct and near the stove is a hinge damper swung from the top of the box and manipulated by a cord and pulley on the corridor wall. Figure 66.

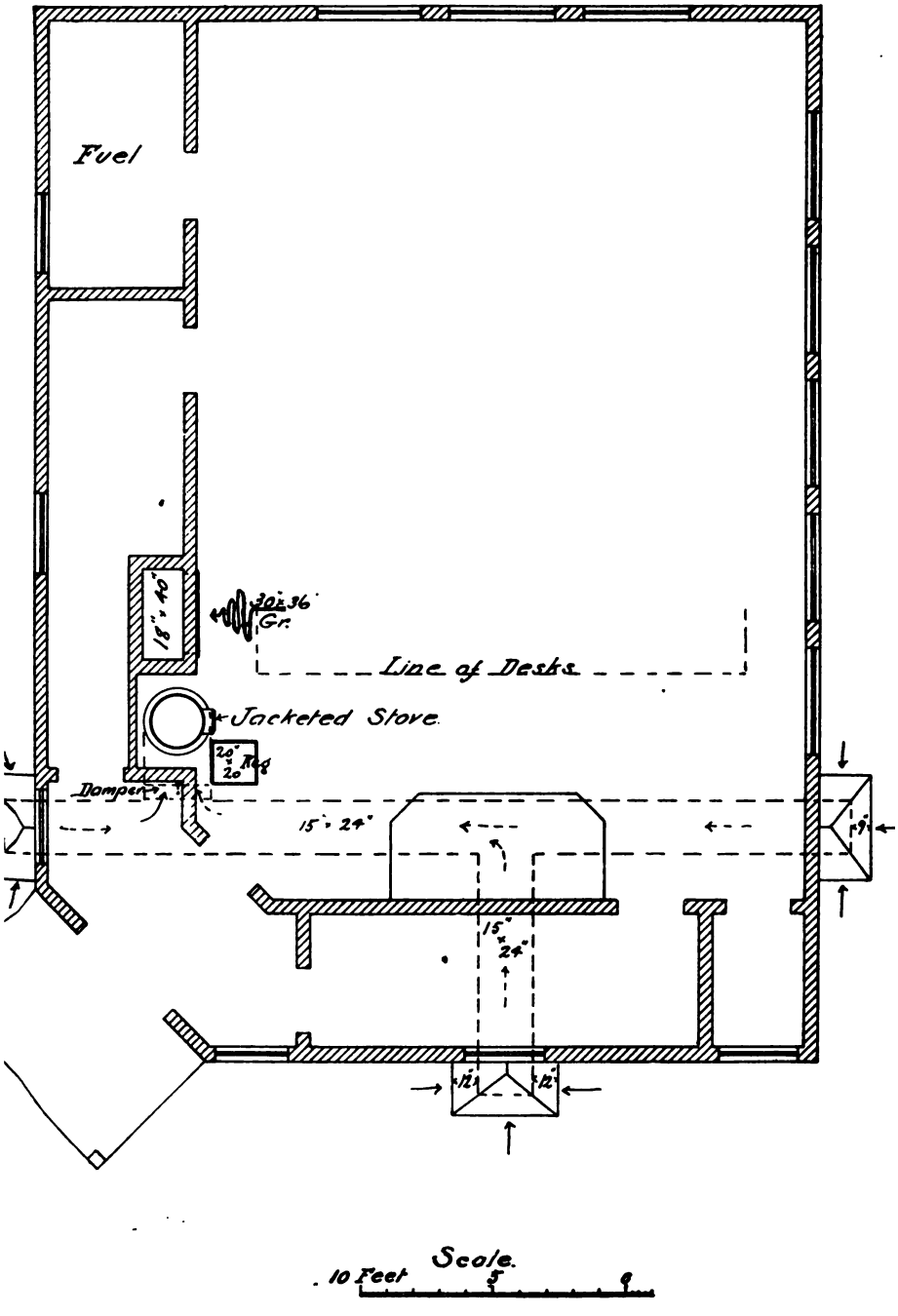

Fuel
18" x 40"
30" x 36"
Gr.
Line of Desks
Jacketed Stove
20" x 20" Reg.
Damper
15" x 24"
15" x 24"
12"
12"
Scale.
10 Feet
5
0

FIG. 64.

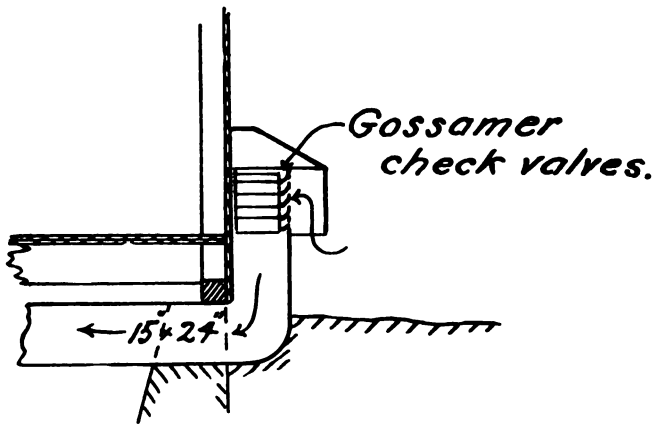


FIG. 65.

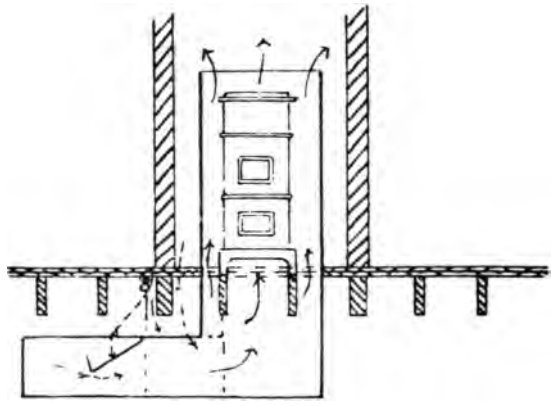


FIG. 66.

In the schoolroom floor is a large register connected with a large sized duct leading to the air box beneath the stove by means of which the air may be rotated for warming the room. It must be closed when the duct damper is open.

A sufficient surface of the front and lower part of the stove should be left uncovered by the jacket to furnish direct heat for drying and warming clothing.

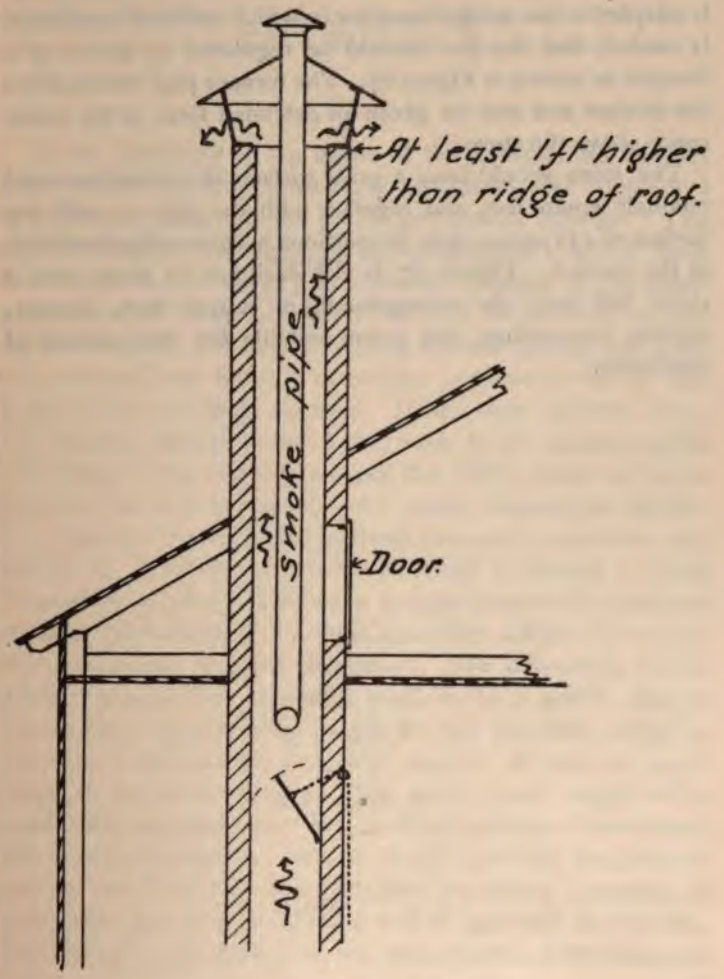


FIG. 67.

The vent shaft is made large because it must be low, and the register face is large to reduce the velocity of flow and the liability of exposing the nearest seat to draught. It is imperative in this instance, as in all cases in which the chimney size is adapted to the mildest weather in which artificial ventilation is wanted, that the flow should be regulated by means of a damper as shown in Figure 67. The furnace pipe enters above the damper and may be given an extended form in the recess space above the stove.

The stove should have a grate surface of at least two and one half square feet, and together with the pipe, a radiating surface of 125 square feet, proportions not generally obtainable in the market. Figure 67 is not designed to show such a stove, but only the arrangements of supply duct, damper, register connections, and jacket suitable for this method of ventilation.

PHTHISIS.*

By the discovery of the germ of this disease, the bacillus tuberculosis, in 1882, by Koch, consumption was transferred in a positive manner to the list of preventable diseases. The constant study, investigation, and experiments which have been made in this country and abroad by many of the ablest physicians and bacteriologists of the day, have shown beyond controversy that the nature of this disease has at last been demonstrated and that it is as much a preventable one as any in the list of avoidable diseases. In the light of these facts, a systematic attempt is now being made by the leading health authorities of the world to educate the public mind as fast as possible, not only in regard to the exact character of the disease, but of the means and methods necessary to prevent and restrict it. To this end the State Board of Health of New Hampshire in 1890 published in its annual report the opinions of many physicians of the State upon this subject, as well as the conclusions deduced therefrom. The magnitude of the disease is such that it would seem to be a public duty to unceasingly urge upon the people the fact that this malady is not only a preventable one, but curable, at least in many cases, in its earlier stages. The public mind ought to be continually agitated upon the terrible enormity of the death-rate from consumption, since it is only by a full comprehension of the facts that the necessary preventive measures to restrict the spread of the disease will be generally carried out. For a graphic illustration of the wide-spread prevalence and

* The terms "Pulmonary Phthisis," "Phthisis," "Phthisis Pulmonalis," "Tuberculosis," "Pulmonary Tuberculosis," "Pulmonary Consumption," and "Consumption" are used in this report as synonymous terms, although some physicians make a slight distinction in their use.

Equally competent authority states that from 170,000 to 180,000 die annually from this disease in the German Empire. D. D. Salmon, D. V. M., chief of the Bureau of Animal Industry, who has given this subject a great deal of study and especially regarding the prevalence of this disease among domestic animals, estimates that the bacillus tuberculosis causes not less than 150,000 deaths annually in the United States. The estimate which he makes is probably in no degree overstated. His calculations were made three years ago upon the supposition that there were 60,000,000 persons in the country, and based upon the actual number of deaths from this disease reported in the census of 1880.*

Thorne Thorne, one of the most eminent English authorities, in discussing pulmonary consumption in that country, says that even after allowances are made for defective diagnosis and nomenclature, the grave fact remains, that in 1888 — the last year for which complete returns are available — there were no less than 53,046 deaths attributed to phthisis in England and Wales.†

CONSUMPTION AS A COMMUNICABLE DISEASE.

The communicability of consumption has been so frequently and so completely demonstrated that the assertion of the fact seems almost unnecessary now. There is, however, a large class of the people who are not conversant with the more recent investigations into the nature of this disease, and to whom this information should be presented. Every person should understand at least enough of the nature of many of the diseases which afflict mankind to be able to use intelligent means to protect himself, his family, and the community against infection. A competent authority gives these conclusions:

That tuberculosis or consumption does not occur except through the agency of the tubercle bacillus.

That the bacillus, though widely distributed over the earth,

* Reports and Papers of the American Public Health Association, vol. XIV. p. 92.

† St. Bartholomew's Hospital Reports, vol. XXVI.

is not generally present in the atmosphere, as some other micro-organisms are.

That the multiplication and development of the bacillus can take place only in a human or animal body.

That the infection of the human being or an animal may occur as the result of breathing in the bacillus, swallowing it in food, or by inoculation through the skin, mucous membranes, or otherwise.

That in man, at least, infection occurs, in a great majority of cases, by means of inhaling the virus.

That practically the only source of the inhaled virus is the sputa of consumptives.

That the sputa is harmless so long as it is prevented from drying.

That when dried it is readily pulverized and floated in the air as an invisible but infectious dust.

That, though the infectiousness of the bacillus is positive and unquestionable, on account of its slow growth it implants itself in the animal organism with some difficulty and only after a considerable lapse of time.

That the power of the bacillus to invade the animal organism and the power of the animal body to resist the attacks of the parasite are very nearly equally balanced.

That this balance of power may be destroyed, in a way unfavorable to the person or animal attacked, by the repeated reinfection of the system, or by inborn or acquired conditions of debility.

That this balance of power may, on the other hand, be destroyed, in a way unfavorable to the parasite, by conditions or influences which strengthen the general powers of the individual, and probably by conditions or treatment inimical to the bacillus.

That heredity as a factor in the causation of tuberculosis is much less operative than was formerly supposed.*

Evidences that tuberculosis is contagious has been shown as positively and precisely in the same manner as in smallpox, scarlet fever, measles, and typhoid fever. It is true that the facts are not as apparent to the ordinary observer as in the other diseases mentioned, for the reason that difficulties of comparison exist, chiefly in the difference in the duration of the diseases, consumption usually being chronic in its char-

* Report Maine State Board of Health, 1889, p. 173.

acter and extending over a comparatively long period of time even in its more acute forms. In the acute contagious diseases it is comparatively easy to note the time of exposure, the period of incubation, the course of the disease, all occurring within a few days, or at most a few weeks time; but in phthisis these stages may be and usually are so insidious and slow in their course that it is not an easy matter to mark a single epoch in the history of the case. Herein lies the difficulty in establishing a belief in its contagiousness, especially among those who have not made a close and careful study of its history. In fact there are many physicians who are clinically familiar with the disease, that have never seen positive proof of its contagiousness. Nevertheless, views established upon such an experience do not hold good for a moment in the face of a single conclusive demonstration of the communicability of this disease, and especially as against the oft-repeated experiments of infection of animals in various ways and under different conditions.

Another very frequent observation which tends to weaken a belief in the communicability of this disease in the public mind, is the fact that a great majority of the persons exposed to the infection of tuberculosis escape the disease. They do not realize that this apparent immunity is dependent upon individual factors rather than upon the disease itself. In other words, it is believed that a person in a perfectly healthy condition, that with all the processes of nature in a perfect physiological state, the disease cannot gain a foothold to the system.

It would be fully as logical to assert that scarlet fever is not a contagious disease because a single case sometimes exists in a family of children without infecting the others, or that measles and diphtheria are not contagious for the same reason.

Another very commonly entertained opinion, now believed to be erroneous, is that consumption is hereditary. Scientific investigation of this disease has led to the opinion that it cannot be hereditary in the true sense of the term, and that if

it is ever transmitted to the offspring it must necessarily appear in the very first years of life. A belief in the hereditary nature of consumption has for generations been held, not only by the people, but by the medical profession as well. This view has doubtless been maintained through the failure to note the difference between heredity and predisposition. In discussing this subject Flick says that in a physiological sense anything transmitted from a parent to an offspring must be an intrinsic part of the parent. A quality, for example, can be transmitted, such as color of hair, complexion, etc.; or traits of character, such as temper, affection, and such like. Disease, however, is an entity in itself, and, therefore, extrinsic to the parent. It is temporarily engrafted upon a person, and unless it can be cast off will put an end to physical existence. As long as even a vestige remains in the body there is a constant warfare between it and the economy. It is quite reasonable that a child conceived, matured, and born whilst this conflict is going on, will or at least may be affected by the same disease which afflicted the parent, for the child is part of the parent; but it is contrary to all reason that a child born of diseased parents, or of healthy parents whose parents or grandparents were diseased, can be healthy at birth, and ten or fifteen or twenty, or any number of years thereafter, develop that same identical disease which the parents or grandparents had, from a something which it got from those parents or grandparents. To accept such a doctrine would be to make disease a physiological condition, or a quality of the body.

Unfortunately predisposition is constantly confounded with heredity, even by the profession. A little thought, however, will clear up the subject to anyone who is willing to give it. Predisposition being a quality of the body, can be transmitted consistently with the laws of physiology; or, in other words, it is hereditary; but disease which is foreign to the body cannot be so transmitted. Parents can give to their offspring a peculiar shape, a peculiar nervous system, a peculiar digestive apparatus, or even condition of the blood which

will make them more or less liable to this or that disease; but they cannot instil into them germs of disease which will in after life unexpectedly develop and crush them to the earth.*

Instead of the disease being hereditary in certain families, as has been generally supposed when few if any of the family escape it, it comes through an hereditary disposition to it, or, in other words, through a lack of certain physiological conditions necessary to protect the person against the infection.

EVIDENCES OF COMMUNICABILITY.

The testimony upon this point is almost unlimited and must, with every candid mind, set at naught all the negative opinions and testimony. We give herewith some extracts taken from reports made to this Board by our own physicians.

Dr. Herbert D. Hicks, of Amherst, says:

I do not believe the disease is hereditary.

The following cases would seem to show the infectiousness of the disease: A man of this town died of phthisis, his two daughters caring for him during his illness. They lived in an unventilated house. Three or four years after, one daughter developed phthisis, lived several years and then died. The second daughter, who was in attendance upon the first, has died of the same disease within a year. Another case, a man of this town, died of phthisis. His son, then a boy of nine or ten years, has developed phthisis within eighteen months of this date (August, 1890); the disease is at present in a quiescent state. The third case, a woman of sixty years, has died of the disease within a few months. She was ill enough to require the care of her son for about ten months, during which time he was constantly near her. He has developed the same disease, which is at present making rapid progress. I can also recall one or two instances where either a husband or a wife has contracted the disease while waiting upon the other. In all these cases enumerated the patients who contracted the disease were previously healthy.

Dr. Edward French, of the New Hampshire Asylum for the Insane, says:

I believe phthisis to be mildly infectious, and I have known

* Transactions of the Medical Society of the State of Pennsylvania, 1888.

a nurse, without any hereditary tendency, to contract the disease from a patient, but I think he was not in robust health—due to overwork.

Dr. Carl H. Horsch, of Dover, now deceased, said:

The case of a strong, healthy wife, with no hereditary tendency, who developed tuberculosis after the death of her husband with the disease, would seem to indicate that the disease is infectious.

Dr. M. C. Lathrop, of Dover, refers to a case, as follows:

Miss P. C., a teacher with previous good health, although from consumptive stock, developed the disease immediately after the death of an intimate friend for whom she had acted as nurse during his last illness with consumption.

Dr. A. W. Mitchell, of Epping, reports the following case:

My aunt died of phthisis, after having been married eight years to a man of robust health with no hereditary tendency. Eighteen or twenty months later he died of the same disease, which ran a course much like her illness. I saw no explanation other than infection.

Prof. William T. Smith, M. D., of Hanover, says:

The disease would appear to have been infectious in the following case: A young woman married a man who died of phthisis, and she died two months after of the same disease. She was strong and well at the time of her marriage, and there was no trace of phthisis in her family. She was one of six children, all of whom were well and strong.

Dr. N. W. Bean, of Henniker, says:

Have known of cases occurring in a family where several other members did not have the disease, while the person who cared for the patients contracted phthisis, undoubtedly from the careless handling of the sputa.

Dr. T. O. Reynolds, of Kingston, says:

The following case, to my mind, illustrates the infectiousness of phthisis: G. B., of Raymond, died of phthisis a few years ago. His wife, who took constant care of him, died in about a year of the same disease. There was never a trace of

tuberculosis in her family, nor did she show the least sign of the disease prior to his death; I knew them all intimately.

Dr. A. H. Harriman, of Laconia, in reporting upon this disease, gives the following:

Believe the disease was due to infection in the following cases: In 1885, Miss A., aged eighteen, married, and immediately assumed charge of her consumptive father-in-law. She died eight months after of pulmonary phthisis. There was no previous history of phthisis in her family and she had always been in good health. A husband, aged about thirty-five, took entire care of his wife who died of phthisis. He died of the same disease in two years; was a very robust man, and had no history of phthisis.

Dr. T. E. Sanger, of Littleton, in recording his observations, says:

In numerous cases, wives who have nursed their consumptive husbands have died within two years after of the same disease, and *vice versa*. Mrs. C., ill with phthisis, was cared for at night by her husband, who developed a cough before she died. Two years after his wife's death, he married a healthy woman, who soon sickened, and died with consumption fifteen months after her marriage. About six months after her death the husband died with the same disease.

Dr. C. S. Rounsevel, of Nashua, says:

I have had one case which I think was much aggravated by, if indeed it was not wholly due to infection; it was a case of a young lady who would persist in sleeping with another who had the disease well developed. There was no history of the disease in her family, but she soon showed symptoms of it, and died in less than three months after the death of her friend, the disease developing very rapidly.

Dr. R. B. Prescott, of Nashua, says:

I have also known healthy wives to contract the disease from phthisical husbands, and *vice versa*.

Dr. William Child, of New Hampton, says:

The cases that I have treated have not in any way been the result of heredity. They may all be accounted for by contagion.

Dr. D. M. Currier, of Newport, says:

Have observed the immediate attendants upon cases sicken and die of the disease when there was apparently no previous tendency thereto. For instance, in a family of three boys and three girls, the oldest girl, from some source, contracted phthisis, and was cared for by the next younger sister, who came down with it a short time after the death of the elder sister. She in turn was cared for by the youngest sister, who also contracted the disease and died about one year after the death of the second sister. Each slept with the patient for whom she was caring. The brothers are strong, robust men; they were not at home during the illness of the girls.

Dr. D. W. Jones, of Portsmouth, says:

I do not believe the disease is hereditary — strictly so. Of course a feeble constitution from heredity would favor the invasion of any disease. Have known healthy wives to contract the disease from infected husbands, and *vice versa;* children from parents; children from other children in the same family — apparently from hereditary influences, but in reality from contagion.

Dr. W. B. Porter, of Walpole, says:

I have known a family where the sanitary conditions, so far as cleanliness was concerned, seemed all right, in which the children to the number of seven all died of consumption, and the disease also appeared in the next generation; but in order to give a satisfactory delineation I should have to go back many years in the history of the family. I am pretty strong in my belief that the disease in the cases just mentioned was due to infection, because there was no care taken to disinfect the sputa or to isolate the patients, the healthy members of the family sleeping with the infected and caring for them without any regard for the consequences.

Dr. Henry I. Bowditch, in a communication to this Board in 1890, said:

I have seen cases in which persons sleeping with others, husband with wife, sister with sister, etc., especially when one is the other's attendant during the day, have had consumption after the sick one has died. I feel so sure that in these cases the disease has been "caught" from the invalid that I always require a separate bed for the invalid, and, if possible, an

adjacent room rather than a bed in the same room with the invalid. I should consider it folly, and almost a crime, to attempt to treat a consumptive patient unless this rule be obeyed. I put this law in operation as my first prescription, and to make it seem less severe, I order it on the ground of good to the patient, who needs fresh, unbreathed air, rather than for the friend's sake. But I always warn the latter of the great danger of persistently disobeying the advice.

In discussing the contagiousness of phthisis, Dr. Lawrence E. Flick, writes:

Either consumption is contagious, or it is not. Whether it is or is not ought to be easily ascertained at the present day. Such diseases as small-pox, measles, scarlet fever, diphtheria, and typhoid fever are universally accepted as being contagious; and the same process of reasoning which led the profession and the public to that conclusion, if the facts are the same, ought to bring them to the same conclusion in phthisis.

The difficulty in the way of making a comparison lies in the great difference in the duration of the diseases — the former always being acute and the latter usually chronic, and, even when acute, of comparatively long duration. This especially holds good in that portion of the disease known as the incubation period. In acute diseases it is comparatively easy to note the length of time which elapses between exposure and determining symptoms of the disease; but in chronic diseases, and especially in phthisis, this is no easy matter. With these facts before us, I will endeavor to show that phthisis is contagious for as many reasons as any of the admittedly contagious diseases, and that it is governed by the same laws of contagion as are the others.

But before proceeding to advance arguments upon the point at issue, it may be well to remove some of the cobwebs of prejudice which have been accumulating for centuries. The most closely woven of these is the theory of heredity. So integral a part of the medical belief of the average man and woman is this theory that to call it into question would to many be *prima facie* evidence of genteel insanity. The world is governed more by belief than by knowledge. Born to the doctrine, most people have accepted it without investigation, and cling to it with fanatical pertinacity. Hereditary consumption, as a theory embodying a scientific truth, will, however, not bear the light of reason. Webster defines hereditary as "transmitted, or capable of being transmitted

from a parent to a child." The word is derived from the Latin "*hereditas*," an heirship, an inheritance, a patrimony. In a physiological sense anything transmitted from a parent to an offspring must be an intrinsic part of the parent. A quality, for example, can be transmitted, such as color of hair, complexion, etc.; or traits of character, such as temper, affection, and such like. Disease, however, is an entity in itself, and, therefore, extrinsic to the parent. It is temporarily engrafted upon a person, and unless it can be cast off will put an end to physical existence. As long as even a vestige remains in the body there is constant warfare between it and the economy. It is quite reasonable that a child conceived, matured, and born whilst this conflict is going on, will, or at least may, be affected by the same disease which afflicted the parent, for the child is part of the parent; but it is contrary to all reason that a child born of diseased parents, or of healthy parents whose parents or grandparents were diseased, can be healthy at birth, and ten or fifteen or twenty, or any number of years thereafter develop that same identical disease which the parents or grandparents had, from a something which it got from those parents or grandparents. To accept such a doctrine would be to make disease a physiological condition, or a quality of the body.

But many will say, Why fly in the face of truth and contradict that which is self-evident? Do not we all daily see the best evidence of hereditary consumption in whole families becoming extinct from it? A careful study of such families and their mode of exit from mortal clay will give the most striking proof of the contagiousness of phthisis. A few examples will illustrate my point:

Family S. has been sadly afflicted by the disease. About five years ago E., a daughter, who was a factory girl and who had worked hard and had been suffering from dyspepsia for a year or more, took the disease. She lived in a neighborhood where the disease was prevalent and she had been making frequent visits, and had helped to nurse a cousin on the father's side, who was dying of the disease. She lingered about two years and died. Her mother, who had undergone many hardships during life, and who was quite delicate and suffered much from dyspepsia, nursed her during her illness. During the latter part of the daughter's illness the mother began to develop the disease, and two years after her daughter's death followed her to the grave. During the mother's illness, the eldest son, who had been lately working indoors, began to develop unmistakable symptoms of the disease. He resumed

outdoor employment, to which he had been accustomed, and after several months recovered and is well at the present day. The father and husband, who had been a very robust man, but who had lived a life of dissipation for many years until within six months of his wife's death, now also developed the disease, and is at present within view of the land of the majority. Family Sh., who lived very close neighbors to the above family, has been almost entirely exterminated by the disease. P., the eldest son, died first, after an illness of six months. In one year he was followed by the father. The mother died next, one year after the father; and she was in turn followed in two years by the eldest daughter. Within less than a year of the latter's death the youngest child died of tubercular meningitis. The only remaining members of the family are two boys and one girl, and, of these, the youngest had every indication of tubercular deposit in the lungs about the time at which his sister died of tubercular meningitis, but recovered, and the other brother is at present apparently struggling with tubercular deposit.

These families are looked upon by their neighbors and by every one who knows them, or anything about them, as practical demonstrations of hereditary consumption. And yet, if those same families had died, in the same order of succession, of a disease which runs a shorter course, no one would have doubted its contagiousness.

If recurrence of a disease in the same family disproves contagiousness, every acceptedly contagious disease can be proven to be non-contagious by the same process of reasoning. In family F., for example, consisting of twelve members, six have had typhoid fever at different times, and in different parts of the country. Is it, therefore, hereditary? Some families will not contract scarlet fever under the worst exposure. Does this disprove the contagiousness of scarlet fever? These facts, individually, lead to false conclusions, but, collectively, argue a most important truth; namely, that there is a family as well as an individual predisposition to certain diseases. Every fort does not yield to the same weapons of assault.

Unfortunately, predisposition is constantly confounded with heredity, even by the profession. A little thought, however, will clear up the subject to any one who is willing to give it. Predisposition, being a quality of the body, can be transmitted consistently with the laws of physiology; or, in other words, it is hereditary; but disease, which is foreign to the body, cannot be so transmitted. Parents can give to their offspring a peculiar shape, a peculiar nervous system, a peculiar

digestive apparatus, or even condition of the blood which will make them more or less liable to this or that disease; but they cannot instil into them germs of disease which will, in after life, unexpectedly develop and crush them to the earth.

The first annual report of the Maine State Board of Health, in discussing the communicability of consumption, says:

Numerous experiments upon animals have shown that tuberculosis may readily be communicated to them by causing them to breathe air into which the tubercle bacillus has been diffused by the atomization of tuberculous matter, or of the pure artificial cultures of the bacillus. That tuberculosis may be communicated to human beings in the same way, the foolhardiness of one person, at least, has shown. While Tappeiner was engaged in his inhalation experiments upon animals, he was assisted by a servant in his fortieth year, who had always been very strong and healthy, and was absolutely free from suspicion of hereditary taint. In spite of energetic and repeated warnings to keep out of the inhalation room, this man, to show the freedom from danger in doing so, persisted in entering the room. In this way he acquired the same form of inhalation tuberculosis which he had so often seen given to dogs, and he died fourteen weeks afterwards. The post-mortem showed the same changes which had been previously found in the dogs that had been subjected to the experiments.*

Recently Vallin, in the French Academy of Medicine, told about a family, whose home the arrival of a consumptive brother transformed into a "house of the doomed," where five persons died of consumption within three years. The family, living in the country in easy circumstances, consisted of father and mother, both of more than sixty years of age, but very healthy, and five children at ages from twenty-five to thirty-two years. The eldest son living in Paris, became consumptive, and, returning to the home of his parents, died in about six months. Within the two years that followed, there died in rapid succession, a sister of thirty, another of thirty-two, a third of twenty-seven, and finally a son-in-law, husband of one of these young women, who had continued to live with the rest of the family after his wife died. It may be added that the sisters who became infected occupied successively the same chamber in which their dead brother had passed the last month of his sickness. Ten years later the father died of apoplexy, and the mother was then living without a trace of tubercle.†

* Zeit für Hygiene, V, 299. † Revue D' Hygiene, XII, 56, 1890.

Dr. A. Ollivier,* physician to l'Hôpital des Enfants Malades, Paris, states that a family previously of robust health occupied two small rooms opening into a narrow court. The parents, a young son, and the baby, slept in one of the rooms. An older son, who had been living elsewhere contracted phthisis, returned home, and slept in the same apartment. He died January 16, 1883. His mother, who was constantly at his bedside, began to cough, emaciated and died of the same disease in the following May. Seven days after the death of the mother, her infant had tubercular meningitis, of which it perished, and a little later the older child who occupied the same apartment, sickened and died like the mother. The father only remained of those who occupied the small room, and his immunity was probably due to the fact that he was most of the time in the open air.

Dr. E. I. Kempf relates the following striking instance of infection (Louisville Medical News, March 22, 1884). In the fall of 1880, a girl of eighteen years, whose brother had died of consumption, was found to have tubercles at the apices of both lungs. She belonged to a sisterhood, and slept in the general dormitory with the other sisters. In four months nine of her companions began to cough, and were found to have tubercles. No one of the sisterhood had previously had disease of this kind.†

Dr. Marfan‡ gives an account of a local epidemic of pulmonary consumption which appears to have been due to infection. In the centre of Paris an office gave employment to twenty-two clerks. The wooden floor was old and uneven, and the building otherwise was far from being in a sanitary condition; but there appear to have been no cases of consumption among the employés before the one of which we are to speak. In 1878, a man who had been in the office twenty-four years, died of consumption after a sickness of three years, during all of which time, excepting the last six months, he had been at his desk in the office, coughing and spitting upon the floor. Since this time, of the twenty-two employés, fifteen have died, one of cancer, and all of the others of consumption. Before the death of the first case, two other men who had been in the office six years, began to cough and spit upon the floor. They died in 1885. For a while the deaths succeeded each other at frequent intervals, the decedents having been in the office for periods of from two to twenty years. It appears to have been the custom to have the office swept every morn-

*Medical News, LV, 651, 1889. †Ibid.
‡Semaine Med. quoted in Revue D'Hygiene, XII, 66. 1890.

ing, and the sweeping was not usually completed before the arrival of some of the employés. When Dr. Marfan, head of of the medical clinique of Paris, advised the office that the probable cause of the heavy mortality had been the inhalation of the infectious dust from the floor, the floor was promptly removed and burned and a new one laid. In future, the sweeping is to be done evenings after the departure of the clerks, and other precautions against the continuance of the trouble were taken.

In the preceding cases it is presumable that the infection was due to the inhalation of the virus — the breathing in of the dried and pulverized sputa. In the following cases the infection was from the alimentary tract.

Dr. W. J. Wilson* observed the following case: B. W., aged four months; family history good, and no trace of phthisis or syphilis discoverable in either family. Had had no previous illness, was plump, fat, and well nourished. The mother was forced to wean the child when about a month old, and it was fed on cow's milk from a bottle, and thrived well for a time, having no digestive troubles. It was attended by a nurse, who was well advanced in consumption. and had free expectoration. The child slept with the nurse, and, consequently, was much exposed to her breath. Nothing unusual was noticed in the child's condition for the first three or four weeks after the nurse's arrival, when it began to lose flesh and cough slightly. This cough and wasting gradually increased, and finally Dr. Wilson was called in. On examination he found well marked and far advanced phthisis, with frequent cough and great emaciation. The child died in its eighth month, three months after the first symptoms were noticed. The same nurse, who later on died of consumption, attended five other children, and four out of the five died of some wasting disease, but as Dr. Wilson did not see any of them, he was unable to state its nature.

A case of infection of an infant through the milk of a tubercular nurse is reported by Dr. Steinberger† of Buda Pesth. An infant aged five months, of healthy parentage, developed caseating cervical glandular abscesses, of a distinctly tubercular kind. Microscopical examination verified the diagnosis. Inquiry elicited the fact that the infant had been nursed for a period of four weeks by a woman who had been discharged on account of phthisis, with abundant expectoration. The etiological relationship was thus clearly established.

* Canadian Practitioner, quoted by Health Journal, XI, 116.
† Pesth med. chir. Presse, quoted by Health Journal, XI, 116,

Professor Demme,* of Berne, has published the following interesting case:

A four months old boy died of tuberculosis of the mesenteric glands. The microscopic examination of the swollen glands, which were partly caseated, showed the presence of the tubercle bacilli. In the intestinal mucous membrane, as well as in other organs, small localizations of tubercle were discovered. Neither on the side of the parents nor of the grandparents had any cases of tuberculosis ever occurred. On the other hand, the child had been fed from birth with the uncooked milk of a cow which was fed upon dry fodder. After the death of the child the physician ordered the cow to be killed. The finding was interesting and instructive. In the left lung of the cow, medium-sized tuberculous nodules were found containing tubercle bacilli. The microscopical examination of the milk, pressed out from the deeper portions of the udder, also revealed the bacilli.

Heller† believes that very probably milk plays a principal part in the so called hereditary tuberculosis of children. In favor of this view is the fact of the frequency of tuberculosis of the mesenteric glands, just that part of the lymphatic system which must be first affected by the tuberculous virus when introduced into the intestinal tract.

Observations like the foregoing and the results of feeding experiments on animals have shown the danger from the use of milk, from suspicious sources, and have led to attempts to determine the magnitude of the danger. An answer was needed to the question whether the milk becomes infectious before the tubercular disease of the cow becomes generalized, and as Bang, of Copenhagen, and others had called attention to the fact that tuberculosis of the udder in the cow is not a rare occurrence, an answer was needed to the question, may the milk become infectious in the absence of tubercular formations in the udder? Hirschberger's recent experiments throw considerable light upon this matter.

He sought to answer two questions: 1. Are the cases frequent or not in which tuberculous cows furnish an infectious milk? 2. In what forms of tuberculosis is the milk infectious? He experimented with the milk of twenty cows affected with tuberculosis of various grades. The milk taken with the necessary precautions was inoculated into the peritoneal cavity of guinea-pigs. His answer to the first question is that the danger of infection from the milk of tuberculous cows is not

*Schweiz. Blätter fur Gesundheitspflege, III, 95. 1888.
†Deutsche Viert. für öffent. Gesundh, XXII, 94. 1890.

only present but it is a very great one; in 55 per cent of all the samples experimented with, the milk was shown to be infectious. In answer to the second question, his results show that the danger of the infection is greater in advanced cases, in which the disease is generalized, but that it also exists in those cases in which the disease is entirely local. From tuberculous cows in which the wasting is marked, the milk is generally infectious; from those that were in good order he found 30 per cent to be infectious. The milk of 80 per cent of advanced, 66 per cent of medium grades, and 33 per cent of localized tuberculosis, was found to be infectious. *

The Massachusetts Society for the Promotion of Agriculture employed Dr. Ernst to investigate the question, as to the danger from the use of the milk from tuberculous cows and at what stage in the disease the milk becomes infectious. Thirty-six cows suffering from tuberculosis other than of the udder were used in the investigations, and 114 samples of milk from them were examined; seventeen samples from ten different cows were found to contain the bacilli of tuberculosis.

Well animals were then inoculated with the result of inducing the disease in 50 per cent of the cases subjected to the experiments. Feeding experiments were also made, with the result of inducing the disease in a number of calves and young pigs. The following conclusions were presented: 1, emphatically, that milk from cows affected with tuberculosis in any part of the body may contain the virus of disease; 2, that the virus is present, whether there is disease of the udder or not; 3, that there is no ground for the assertion that there must be lesion of the udder before the milk can contain the infection of tuberculosis; 4, that, on the contrary, the bacilli of tuberculosis are present and active in a very large proportion of cases in the milk of cows affected with tuberculosis, but with no discoverable lesion of the udder.

It will thus be seen that Dr. Ernst's results and conclusions are essentially the same as those to which Dr. Hirschberger arrived.

The Tuberculosis Congress in Paris spent much time in the discussion of the question as to the permissibility of using as food the flesh of tuberculous animals in the earlier stages of the disease. There was a difference of opinion as to the expediency of absolutely interdicting the use of such meat. Recognizing the difficulty of drawing a line to divide the cases in which the flesh may be used from those in which it may

*Deutsche Med. Woch., XVI, 118. 1890.

not be used, the Congress eventually passed a resolution to the effect that all animals affected in any degree with tuberculosis should be seized and condemned as unfit for food. This was carried with only three dissenting votes.*

At Munich some experiments have been made by Stenhiel† as to the possibility of infecting guinea-pigs with the products from the muscles of persons affected with phthisis. The material used was portions of the psoas muscles of nine patients, who died of phthisis. The muscle was cut up into very fine pieces, and submitted to the pressure of a screw press. The juice obtained was injected into guinea-pigs. Of eighteen guinea-pigs thus treated, fifteen died of tuberculosis, although no tubercle could be detected in the muscle so used. Steinheil draws the conclusion, that the muscular flesh in advanced human phthisis is infectious as a rule; hence, the possibility that the flesh of animals affected with bovine tuberculosis is dangerous, cannot be denied.

The destruction of tuberculous cattle in New Hampshire by the board of cattle commissioners is doing much to remove from our State one of the great sources of infection. The board has caused to be destroyed all the cattle found to be infected with this disease. It has also established a strict quarantine against infected cattle from Massachusetts, and it is confidently believed that the disease can be almost, if not quite, stamped out of our herds if the work of the commission is continued without interruption.

We insert herewith a valuable paper read before the Boston Society for Medical Observation, by Dr. J. A. Jeffries, of Boston, on "How Tuberculosis is Acquired."

HOW IS TUBERCULOSIS ACQUIRED?

The question is, How does the tubercle bacillus gain access to our bodies and those of our domestic animals? Tuberculosis is frequently spoken of as being an hereditary disease; this it is not and never can be. The characters of life, the laws which make us born men rather than something else are hereditary, but not the presence or products of a parasitic

*Medical Record, XXXIV, 218. 1888. †Public Health, II, 285. 1890.

disease. Where the offspring is born tuberculous, it is a case of congenital disease. Such cases occur in cattle, beyond all question. Thus Blaine* reports two cases of eight months calves born with tuberculosis; Misselwitz† reports two cases of fœtal calf tuberculosis; Malvoz and Brouwier,‡ the case of an eight months fœtus with tuberculosis of the cord, the liver, and the glands at the roots of the lungs; and Johne§ a similar case with one small nodule in the lungs, many in the liver, and enlargement of the bronchial and portal glands. In the last two cases tubercle bacilli were found in large numbers.

Turning to man, the record is much less complete. Birsch-Hirschfeld‖ reports the case of a child delivered with uninjured placenta by Cæsarean section. Microscopic examination showed large numbers of tubercle bacilli in the placenta and a few in the veins of the liver, but no tubercles in either organ. Scanzoni¶ found advanced acute infiltration of the lungs and tuberculosis of the peritoneum in a dead-born child. Scanzoni's case dates from 1852, is briefly reported, and could not stand by itself. Birsch-Hirschfeld's is of recent date and of the best authority. We must therefore accept that the parasite can gain access to the human fœtus.

Does congenital affection often occur? Can the bacillus gain access before birth, and lie latent for fifteen or fifty years, as claimed by some, and then suddenly become active, and kill its host? The paucity of records shows that congenital infection is very rare. That the second is possible there is not an iota of evidence; it is only a comfortable way of explaining what is not understood. Against it, much can be cited, as the rarity of proved congenital infection and the activity of the germ in the young. The lesson is that we must be careful of the maternity of our experiment animals. Congenital infection is not a factor of importance in the propagation of tuberculosis.

*Medical Record, 1887, vol. i, p. 60.
†Seidamgrotsky's Berich., 1889, from Baumgarten's Jahresber, 1890.
‡Ann. d'Instit. Pasteur, 1889, p. 153.
§Deut. Zeit. f. Thiermed., Bd. ii, 1884, p. 207.
‖Deut. med. Woch., 1891, No. 11, p. 404.
¶Lehrbuch der Geburtshülfe, 1852, p. 358; after Epstein.

Passing to infection after birth, we can endeavor to track the bacillus from its course to the point of entrance into the system, and also draw inferences as to the mode of infection from the history and occurrence of the disease and an autopsy. The bacilli can be directly transferred from one animal to another, as by contact or the consumption of diseased portions, or they can first leave their seat of growth, become part of the dust, and later gain access to the second animal.

To take up the simplest question, that of direct contact, there is no doubt of its occurrence. Medical literature contains many such cases, from kissing to the Jewish ritual. But though the cases are striking, often self-evident, the number on record is insignificant when compared with the prevalence of the disease. Probably indirect inoculation plays an important part; at least no other explanation of the mass of lupus, skin tuberculosis, and scrofula of the superficial glands is at hand.

The question of food cannot be so easily treated; it is involved in many difficulties. At the first step we meet a stumbling-block. In what foods does the tubercle bacillus occur? In those derived from tuberculous animals. The remedy is therefore apparent: do not eat any portion of such animals, have all cattle inspected, and all those affected in any way condemned. Very good, very radical, very expensive, but not perfect. The inspectors could not enforce the law, could not recognize the cases. It is therefore best to consider food under various heads, so as to gain an idea of the amount of danger, and adopt measures to meet the special conditions. Though actually diseased portions do not figure as an article of human diet, I give the summaries of Johne, Wesener, and Biedert, since they show the danger from food under the most favorable conditions for infection.

Johne* found 117 animals fed with tuberculous material from cattle, with 61.5 per cent positive, 34.2 per cent negative, and the rest (4.3 per cent) doubtful results. Forty-one were fed with the flesh of tuberculous animals, with 13.1 per cent

*Deut. Zeit. f. Thiermed, 1883, p. 1.

positive, and 86.9 per cent negative results. All those fed with cooked flesh gave negative results. Dividing the experiments according as the food was cooked or not, he gives 259 fed with raw material with 47.7 per cent positive, 48.9 per cent negative, and 3.3 per cent doubtful, as compared with 35.5 per cent, 64.4 per cent, and 1.6 per cent respectively, when the food was cooked.

Wesener's* figures are not so suitable for our purposes, still he agrees with Johne that all experiments with cooked flesh are negative. There are, however, a few apparently positive cases reported in which cooked viscera were fed to swine.

Biedert† gives the figures as 548 animals experimented upon, with 119 positive, 367 negative, and 64 doubtful results. It will be noted that Biedert gives a much lower positive percentage, and much larger doubtful, than Johne. This difference is due to the exclusion of all cases where the control animals became tuberculous. The number of positive results (21 per cent) is very low, in view of the amount of tuberculous material fed, and shows clearly that animals are slow to contract the disease from their food. Many objections were made to these experiments at the time; but, to my mind, the only important one from our point of view is that nearly all the animals were put on food which was not suitable for them. The carnivora in Johne's list are sixty pigs, twenty dogs, and nine cats. The dogs and cats I have not been able to trace to the original sources, but it is worthy of note that Wesener classes the cats as all negative. Pigs give the best result, it making no difference if the food is cooked or not, which strongly suggests error. Sauer's‡ note, that the animals in a zoölogical garden were fed for years on tuberculous meat, without contracting the disease, is of interest in this connection.

To return to the state of affairs with men, law and custom combine to reject the whole of highly tuberculous, emaciated cattle, but allows the sale of flesh from animals with localized

*Kritische und experimentelle Beiträge sur Lehre von der Fütterungstuberculose, Freiburg, 1885.

†Jahrb. f. kinderheilk., N. F., 21, 1884, p. 158.

‡Der Thieartz, Bd.,xvii, p. 17.

tuberculosis, if in good condition. What danger do we incur by eating this meat? Many are calling for the total condemnation of all tuberculous cattle. There are very few, if any, records of tuberculosis in normal muscle, which will stand criticism. The danger, therefore, is confined to the germs which may have slipped into the general circulation shortly before death. To determine this danger many experiments have been made by inoculating the juice pressed from the flesh of highly tuberculous cattle into rabbits and guinea-pigs. I have collected from Arloing,* Dreschfield,† Galtier, ‡ Kastner,§ and Nocard,‖ the tests of 59 cattle, with 13 positive results, all from highly affected animals. Besides there are Steinheil's¶ experiments with the flesh of people dead of phthisis, with nine trials and some positive results. As dead cattle are not allowed in the market, these results do not apply. Also, Bollingér states that Kastner has recently made five tests with condemned flesh, all positive, and one with flesh from a highly tuberculous but not condemned case, with negative results.

From the above we are justified in concluding that tubercle bacilli, in meat as sold under inspection, are rare. What effect, if any, the long keeping of the meat before eating has upon the bacillus, is not known. This should be inquired into, since muscles become acid on coagulation, and acids have a distinctly deleterious effect upon tubercle bacilli. The mass of our meat is cooked before being eaten, and in this way what danger there is, is greatly reduced. This is shown at once by the experiments on animals (all negative), and the fact that heat, such as that applied to ordinarily cooked meat, is sufficient to kill the bacilli.

The results of feeding man with tuberculous meat, reported by Schottelius,** are of interest. The people about Wurzburg, believing such meat to be harmless, made so much com-

*Congrès pour l'Etude de la Tuberculose, Paris, 1889, vol. i, p. 59.
† Cited by Ransome, No.
‡ Congrès pour l'Etude de la Tuberculose, vol. i, p. 76.
§ Münch. med. Woch., 1889, Nos. 34 and 35.
‖ Congrès pour l'Etude de la Tuberculose, vol. i, p. 49; Bullet et memorie de la soc. centrale de med. Veterin., 1885, t. iii, p. 49.
¶ Münch. med. Woch., 1889, Nos. 40 and 41.
** Virchow's Archives, Bd. 91, p. 129.

plaint that its sale, under careful supervision, was allowed, during a part of 1868. The carcases were bought whole, and divided between twelve families. In all, 49 cattle were consumed before the authorities gave up keeping the record. If such food is dangerous to any degree, the result should have been a marked increase in the amount of tuberculosis in the twelve families, as compared with the rest of the population. This was not the case. Up to the time of report, in 1883, there had not been a case of tuberculosis which could be attributed to the food, though surely seventy people regularly lived on it.

Also, Bollingér* cites the town of Ritterwiesen, where there was much tuberculosis among the cattle. Yet in spite of the general consumption of their flesh and milk by a population of 425, there were only three deaths from tuberculosis during the years 1874–78, inclusive. Curiously enough, none of the three deaths occurred in the families which ate the flesh. The same author inquired into the history of all the foundling families known to consume tuberculous meat, and failed to find a single case of tuberculosis.

To sum up, there is little absolute proof that raw flesh, when consumed in the course of nature, is dangerous. Yet, after making allowances for the inaccuracies of experiments, there is no doubt but that there is some danger. As regards cooked flesh as consumed by man, there is no evidence of danger, though we have many records where bad results might justly be expected were they at all common. I do not mean to oppose inspection — far from it. All cases of general tuberculosis should be condemned; but I do not believe that the danger justifies the total seizure of all tuberculous cattle. The expense is too great; the same amount of money will produce better results when applied in other ways.

Milk, often consumed raw, and at one time or another an ingredient of the food of every human being, is generally accepted to be a greater source of danger than flesh. It has long been known that the tubercle bacillus is liable to occur in

* Aerztl. Intellgzb., 1880, p. 409.

the milk of tuberculous cows; and much time has been spent in an endeavor to gain an exact knowledge of the danger. There are four classes of observations to consider—feeding experiments, dating back to Villamain; inoculation experiments; direct microscopic study of the milk; and the prevalence and nature of tuberculosis among the consumers of raw milk, chiefly the young.

I have only been able to collect a few of the reports on feeding, since the articles are mostly in out-of-the-way places, and not specially indicated by the titles. They are, as far as possible, briefly summarized.

Gerlach* fed the milk from a cow showing marked tuberculosis of the thorax at autopsy (other organs not noted) to a number of animals. These, killed at intervals, showed tuberculosis, more or less general, throughout the body. All the animals received other food than that from the cow. There were no control animals, and no note of precautions taken to avoid other modes of infection.

Schreiber† fed three guinea-pigs and eighteen rabbits with the milk from a tuberculous cow for some time, results negative.

Bang‡ has fed the milk from five cows with tuberculous udders to pigs and guinea-pigs, with positive results in all.

Cavagnis§ reports three young guinea-pigs suckled for eight, twelve, and thirty-two days by a tuberculous mother, with negative results.

Peuch‖ fed 4.470 grammes of milk from a cow with tuberculosis of the udder to a pig. This, killed fifty-six days later, was found to be normal. (Four rabbits inoculated at the same time developed tuberculosis.)

Ernst¶ has reported the result of feeding thirteen calves with the milk from thirteen cows supposed to be tuberculous and free from tuberculous disease of the udder. In five of the

*Virchow's Archives, Bd. 51, p. 290.
†Zur Lehre von der artificiellen Tuberculose, Diss. Inaug., Königsberg, 1875.
‡Deutsch. Zeitschrift f. Thiermed., Bd. xi, 1884, p. 45.
§Baumgarten's Jahrb., 1888.
‖Congrès pour l'Etude de la Tuberculose, vol. i, p. 73.
¶Transactions Association American Physicians, vol. iv, 1889.

calves tuberculosis was found; in seven none; and one was suspicious. Only eight of the calves were fed with the milk of one suspected cow; three of these were found tuberculous. In all, six cows were used. Of the three infecting cows, two had disease of the udder. In one no autopsy was made. In all three calves there were tubercles in the liver, and, in one, in the kidney. None were reported in other parts of the body. No control animals were reported.

Besides the above, there are many more, as Wesener, in 1885, gives the figures as eighty-six animals experimented on, with positive results in the two calves, three quarters of the pigs, half the sheep and goats, two fifths of the guinea-pigs, very few of the rabbits, and none of the cats. How many animals the milk came from, or the state of the udders, is not given; probably most had trouble in them, as at that time experimenters were working for effects, not relative danger.

These results are not striking, considering the source of the milk, and accepting them as they stand. Probably in most cases the results as given represent the facts; but control animals, less advanced lung trouble and more intestinal trouble, would have made them stronger. Affection of the mesenteric glands, as will be shown later, is not a proof of intestinal infection. It is also unfortunate that pigs fed on boiled milk were affected, for the bacilli in these cases must have come from elsewhere.

There are quite a number of inoculation experiments which are chiefly of value owing to the sensitiveness of the test. They only demonstrate the possibility of danger, and in no way show that the milk would have been injurious if consumed in the ordinary course of affairs.

Hirschberger* has experimented with milk taken in the laboratory from the udders of slaughtered cows. An admixture of blood was avoided as much as possible. His results were, with highly tuberculous cows, four among five positive; with middle-grade tuberculosis, four among six positive; and with pulmonary phthisis only, three among nine.

*Deutsch. Archiv. f. kl. Med., Bd. 44, 1890, p. 500.

All told, eleven positive results in twenty trials. Udders presumed to be normal, but no careful examination made.

Peuch* injected ten, twenty, thirty, and forty grammes of milk, from a cow with tuberculous mammitis, into four rabbits. All died of tuberculosis.

Nocard† has tested the milk from ten cows with advanced tuberculosis, but none of the udder, with negative results throughout.

Martin‡ has tested thirteen lots of city milk. He classes the results as three negative, one positive, five doubtful, and four discarded. Personally I should discard one, class eleven, as distinctly negative, and the other as doubtful. Tubercle bacilli were not sought for, but bits produced the disease in other guinea-pigs. The trouble very likely was pseudo-tuberculosis; but granting that it was tuberculous, the autopsy does not read like a case of inoculation into the abdomen. The lesions in the abdomen were fresh; the omentum was free from trouble; and the bronchial glands were enormously enlarged.

Bang§ experimented with the milk from two cows with advanced tuberculosis but normal udders; results, one positive and one negative. Later, he reported trials from twenty-one cows with general tuberculosis and no disease of udder, with only two positive results He also tested the milk from eight phthisical women, with negative results. Later still, he reports the result of another series of twenty-one cases with seventeen negative and four positive results. Of the four positive results, three had tuberculous udders and the other was doubtful.

Stein‖ has inoculated the milk from fourteen cows, taken (like Hirschberger) after slaughtering, from the amputated opened udder. In four cases, he claims positive results. In

*Congrès pour l'Etude de la Tuberculose, vol. i, p. 73.

†Ibid., p. 49.

Revue de Médecin, 1884, p. 150.

§Congrès pour l'Etude de la Tuberculose, vol. i, p. 69; Münch. med. Woch. 1890, p. 705.

‖Experimentelle Beiträge sur Infectiositat der Milch perlsüchtiger Kuhe. Inaug. Diss. Berlin, 1884.

two of these the udder was affected; in one is given as "normal but yellow"—that is, not normal; in the fourth no statement is made. Why the third case is classed as positive is difficult to perceive, since the only evidence was some enlarged lymphatics, in which no bacilli could be found. Other similar cases are classed as negative.

Cavagnis* inoculated the milk mixed with blood, from a tuberculous cow, and got a positive result. The udder is given as apparently healthy.

Ernst† got seven positive results by inoculation of milk from fourteen cows, udders healthy.

Galtier‡ has reported inoculations from two cows, one with and one without tuberculosis of the udders. The first gave a positive, the second a negative result.

Taking the figures just as they stand, we have one hundred and twenty-five trials with cows' and women's milk, with thirty-two positive and ninety-three negative results. Of the positive results eight are given as having tuberculosis of the udder, twenty-three as not, and one doubtful.

My judgment leads me to reject all cases where the udder was opened after slaughtering. This would reduce the positive results to ten with no tuberculous disease of the udder—the three of Bang and the seven of Ernst. Bang, in his last notes, evidently inclines to the view that bacilli are at least very rare in milk when the udder is not tuberculous. Of Ernst's seven cows, autopsy is lacking in six; four showed some form of disease of the udder; and in the one autopsied this was tuberculous. This alters the figures most strikingly, and reduces as to Bang's three cases, which, as already stated, he does not put much weight on, and three of Ernst's cases without autopsy. It is hardly necessary to call attention to manifest difficulty in proving the absence of tuberculosis in a large organ like the udder.

Searching for the bacillus in milk as a test is not of practical value for our purposes. In milk from ordinary tubercu-

* Baumgarten's Jahrb, 1888.
† Transactions Association American Physicians, vol. iv, 1889.
‡ Congrès pour l'Etude de la Tuberculose, vol. i, p. 81.

lous cattle, slide after slide must be gone over in the hope of finding a bacillus among a number of other bodies, which, after hours of fatiguing labor, are only too apt to get the better of tired brain and eye. Of the truth of this statement I have seen many a practical demonstration. Even if the plant only occurs where there is disease of the udder, inspection does not give security, as the early diagnosis is very difficult. But as only a small portion of the tuberculous cows have tuberculous udders, the amount of tuberculous milk would in this case be quite limited.

The occurrence of tuberculosis among calves, infants, and a few other groups of milk consumers, alone remains to be considered. Since calves are exclusively fed on raw cow's milk, they offer the very best of natural experiments as to the danger of milk. I have collected from various sources* the slaughter-house reports of the amount of tuberculosis in calves.

23,557	calves with . . .	2 cases	of tuberculosis.
30,477	" . . .	1 case	"
143,218	" . . .	35 cases	"
23,592	" . . .	1 case	"
800,000	" . . .	5 cases	"
24,766	" . . .	1 case	"
87,685	" . . .	26 cases	"
1,133,195		71 = .006	per cent.

These figures can be explained in several ways: first, that calves are only infected with difficulty by tubercle bacilli in their food; second, that there are very few bacilli in milk; third, that the disease does not have time to develop before the calves are killed; fourth, that tuberculous cattle do not suckle their calves.

Our evidence as to the first is not extensive, but, so far as I know, calves fed with milk known to be tuberculous have become tuberculous themselves. This is in accord with the

*Propagation of Tuberculosis, by Lytded, Fleming, and von Hertsen; Woch. f. Theirheilte, 89, No. 9; Am. Vet. Journal, January, 1889, and May, 1890.

condition of the digestive tract and the general law of susceptibility in young animals of all kinds. We are therefore justified in rejecting this proposition.

There is a good deal to be said in favor of the supposition that the disease does not have time to develop before slaughtering. Calves are killed, I am told, chiefly when from four to six weeks old, but the age may be more or less. The time is short. On the other hand, much can also be said against it: first, the calves found tuberculous prove that the disease can be recognized; second, the time is sufficient for the development of the two lesions to be expected from intestinal infection, those of the intestine and of the lymphatics of the mesentery. Again, young cattle, though more affected than calves, offer very few cases of tuberculosis. That tuberculous cows do not feed their young has nothing to support it. They are just the cows most liable to, as it is the poor milk which goes to the calf.

The second proposition, that there are but few bacilli in the milk of most tuberculous cows, is the only one left. This, taken in connection with the fact that the milk from cows with advanced tuberculous udders is so bad as to preclude its use for any purpose, affords a satisfactory solution.

I have reasoned as though all calf tuberculosis was due to food. This is certainly not the case; much is surely due to inhalation.

How about babies? They are the important test. Are many cases of infection from milk recorded? Certainly not, as shown by the difficulty in finding any. I have, however, found the following, and like enough there are as many more.

Leonhardt* reports the case of a healthy infant of healthy parents, which was weaned and put on cow's milk. The child soon died of tuberculosis of the meninges, intestines, and mesenteric glands. The cow which gave the milk was found to be tuberculous. Another child fed from the same cow died, at about the same time, from tubercular meningitis.

Sontag† reports the case of a six months infant of healthy

* Correspondenzbl. d. Niederrhein Ver. f. öffentl Gesundheitspfl., 1877, p. 213.
† Siedamgrotzky's Ber. u. d. Vet. i. König, Sachsen, 1889.

parents, which at autopsy showed miliary tuberculosis of the meninges. It was fed with milk from a tuberculous cow.

Hermsdorf* gives three cases in which there was extensive intestinal tuberculosis, besides less of other parts. One had taken uncooked milk from a tuberculous cow. The original not seen, but the reviewer seems to doubt one case at least.

Demme† reports the case of a four months infant, which at autopsy showed tuberculosis of mesenteric glands; bacilli were found, but none elsewhere, in spite of great care. There was no tuberculosis in the family for two generations on either side. The milk came from a cow with general tuberculosis. Microscopic examination of the milk pressed from the depth of the udder gave a positive result after examining twenty to thirty cover glasses—not clear, but milk apparently, taken from the udder at autopsy.

Bollingér cites Stangs'‡ case of a boy five years old, who sickened with ascites and enlarged glands in the abdomen. At autopsy the chief lesion was tuberculosis of abdominal lymphatic, but also tuberculosis of serous membranes and lungs. There was no tuberculosis in the family for two generations. The child had for years been in the habit of drinking milk warm from a cow, which, growing thin before the boy died, was killed, and found to be tuberculous—how much or where is not stated.

Some of the above cases are quite conclusive, though not absolutely beyond the possibility of error. The other cases, though probable, are not conclusive, as the following case of Toulmin shows:

A child, breast-fed, of healthy family, in healthy house, did well till at the ninth week it moved to rooms previously occupied by a phthisical woman. In one week the child began to sicken, and died when four months old. The autopsy showed enlarged and cheesy glands, in the anterior mediastinum; one small tubercle of the anterior wall of the right

* Uber primäre Intestinaltuberculose, wahrscheinlich durch Nahrungsinfection bedingt. Inaug. Diss., Mün., 1889.

† Med. Bericht ü. d. Thäligkeit des Jenner'schen kinderspitales in Bern, 1886.

‡ Deutsch. Zeitschrift f. Thiermed., ii, 1875, p. 281.

ventricle; lungs much affected, with cavity the size of a marble; bronchial glands cheesy and soft; spleen enlarged; tubercles in spleen, liver, kidneys; ulcers of jejunum, ileum, Peyer's patches, cœcum and colon; mesenteric and retroperitoneal glands enlarged and cheesy.*

On the other hand, Bollingér has collected the cases of a number of families which habitually used milk from tuberculous cows without catching tuberculosis. Out of twenty-two families only one man was found who could possibly be called tuberculous, and this man used no milk, only cream in his coffee.

Typhoid patients afford a fair test of the infectiousness of milk. Here we have a large number of people with erosions and ulcers of the intestines; yet, in spite of their extensive milk diet, no one has discovered that tuberculosis is a sequel.

To review the evidence as regards food, we see that tubercle bacilli are rare in flesh as sold in the markets, and that neither experiments nor observation have shown that flesh is more than a remote danger to man. Milk is an undoubted source of infection; but the results of experiments and observation on man and cattle indicate that it is not a great one.

I have ignored Brushe's argument, that human tuberculosis is due to cattle, since it only occurs where cattle are kept, for two reasons: first, doubt as to the facts; and, second, the fact that the cattle may be exempt though the people are afflicted.

Infection from dust and dirt alone remains to be considered. That tubercle bacilli are cast into our surroundings in vast numbers is self-evident. The number thrown out per annum in the sputa of the phthisical far exceeds the comprehension of man. A larger number are spit out in the sputa, and go into spittoons, on handkerchiefs, clothing, furniture, carpets, and the ground. A smaller number are coughed out, often in very small particles of phlegm, and are scattered over everything in the vicinity, provided a handkerchief is not applied to the mouth, as is sometimes done — I say sometimes,

*Toulmin: Johns Hopkins Hosp. Rep., vol. ii, No. 1, 1890.

for most do not practice this so called refinement — in reality a hygienic measure. The readiest way to satisfy one's self of the size and amount is to hold some object before the face of the cougher. I have several times during the last few years observed people cough before a window. The result is instructive. The same is true of sneezing, except that the particles are finely divided and almost form a spray. The result is to distribute the tubercle bacillus all about the sufferer. The same is true to a greater or lesser degree of every tuberculous lesion discharging on the surface. The bacilli escaping in human dejection go, in the great majority of cases, to places where they can do no harm. The same thing goes on with all tuberculous animals, except that the horned animals do not spit out what they cough up. Some have jumped from this to the conclusion that they do not cough out anything; this is not correct.

The dust has been chiefly studied by Cornet,* and his article is so well known that it is only necessary to state that, out of three hundred and eleven trials with the dust and dirt from spaces occupied by phthisical patients fifty-nine gave positive results. All of seventy-seven trials made with other spaces were negative. Several other experimenters have made similar trials with similar results.

Rembold† and others have sought for and found tubercle bacilli in the air. Three methods have been used: a coverglass with a miscous coat placed in a draught, and subsequent microscopic examination; drawing air through a cotton plug, and then putting the plug in a guinea-pig; and exposing plates with a thin layer of glycerine to the air, and then washing and using the wash-water. There is, however, a dearth of this sort of work; extended and varied research in this line is a desideratum which no private individual is liable to fill.

Spillman‡ and Hofman§ have found that flies carry the germ in their intestines and deposit in their droppings, and

*Zeitschrift f. Hygiene, Bd. v, 1888.
†Centralbt. f. Bact. u. Parasit., vol. vii, p. 199.
‡Compt. Rendu., cv, 87, p. 352.
§Centralbt. f. Bact. u. Parasit., vol. iv, p. 269.

Hofman in one case out of four found the bacilli in flies' guts virulent when inoculated into the eyes of rabbits.

As might be expected, tubercle bacilli have been found on the bodies of consumptives and their toilet articles.

We, therefore, know, without going any farther, that tubercle bacilli are liable to be all about us. And only two things interest us: first, How many are alive — that is, capable of infecting? and how can they get into us and our animals? A dead bacillus, or one fastened down, is of no import. When first escaping from the body many, probably most, are alive; this is proved by the extreme susceptibility of our inoculation test. The first question is, therefore, How long can they live? And to this we can safely answer, Months at least. Drying, putrefaction, sunlight, are all detrimental to the plant and tend to destroy it; but none of these are prompt or sure.

Stone* has shown that the tubercle bacillus may be virulent in sputa after three years, during at least two of which it had been in a state of absolute dryness. Cadeac and Malet† found that the lungs of tuberculous cattle dried, powdered, and then exposed to the air of a room, were virulent at the end of one hundred and two days. A piece the size of the fist, dried and exposed to the air, infected at the end of one hundred and fifty days; a similar piece, buried in a three-litre flask filled with sand, was virulent at one hundred and fifty-nine days; also pieces in a flask of water exposed to sunlight for one hundred and twenty days, and others in running water for one month, were virulent. Heim and Galtier have shown that the plant will live from one to four weeks in milk and its derivatives. It also lasts well in water (Cantamese and Vidal). It is therefore clear that, in spite of certain experiments pointing to the rapid death of the germ in the presence of putrefaction, it is quite liable to last for a long time. It must be borne in mind that all putrefaction processes are not alike.

There is therefore no doubt about the extensive distribution of the live bacillus in our dwellings; as yet it has not been found out of doors, but it must be there.

*Am. Journal Med. Sciences, March, 1891.
†Congrès pour l'Etude de la Tuberculose, vol. i, p. 76, 1889.

From the general dust to the interior of our bodies is but an easy transition. Every tramp of the foot, quick motion of the arm, is liable to raise a host of bacteria. The broom and feather duster are finely adapted for raising them up; once up they may be breathed in. Tubercle bacilli are not different from others except in their rather enduring life, and we know that the air contains many germs. Besides the air the plant can gain entrance by direct contact while lying still. We touch everything, and much remains on our hands. We all know that it does not do to scatter red pepper in our rooms; it is soon in our eyes and noses. Babies are particularly bad in this respect; everything grasped goes into the mouth; and given a coming or going tooth, the opportunities for inoculation are excellent. Has this any connection with the prevalence of scrofulous glands in the neck during youth?

What we have now to consider is the evidence that such a theoretically potent factor is such in fact. Naturally we have not the number of striking observations afforded by direct infection; we cannot trace the invisible bacillus with the directness that we can infected food, and can never, so far as mechanics are concerned, be sure into which organs the plant entered. Of this the case of Toulmin already given is an illustration; where the bacilli went to, the laws of physics do not show. Those in the air probably settled along the respiratory tract, those conveyed by contact probably into the mouth, and thence either out again or into the stomach.

Besides the above I know of but one case, that of Kruche. A boy of healthy family, strong and well, occupied for a few weeks the room and bed previously used by a phthisical patient with profuse expectoration, and shortly died of miliary tuberculosis. Cattle show the same thing, it being not unusual for tuberculosis to begin with a new cow at one end of a row of cattle and travel along, stall by stall.

Cornet's* reports on the prevalence of tuberculosis among the religious orders which care for sick indicate indirect infection on a large scale. He found that for twenty-five years

*Zeitschrift f. Hygiene, Bd. vi, 1889.

the average membership had been 4,028.8, total deaths 2,099: of these 1,320 (62.88 per cent) from tuberculosis, and 13.94 per cent from other parasitic diseases. These figures are not isolated; the same thing crops out in hospital records, prisons, reformatories, and even barracks, in spite of the extensive outdoor exercise of the troops.

Records such as that of Sendter* and Kempf† are of significance. The former notes that on the Island of Frauen Chiensee, with a population of about three hundred souls, the deaths from tuberculosis since 1800 never exceeded seven in the decade until the last; while the cloister, with from twenty to forty members, was immune until 1860. During the sixties two died of tuberculosis; the same in the seventies; while during the last decade eleven fell victims. The latter records a convent in which a case of tuberculosis occurred in a girl of eighteen, and was followed in four months by nine more; after which the sufferers were partly put in separate rooms and isolated, partly transferred to other asylums, and the rooms cleaned, after which no more cases occurred.

The difference in the amount of tuberculosis between the single, married, and widows and widowers, is of interest in this connection. Destree and Gallemært's‡ table for Brussels, calculated to the ten thousand for each age, sex, and state, is given below:

Age.	Single.		Married.		Widowers and Widows.	
	Male.	Female.	Male.	Female.	Male.	Female.
20–25	87.0	67.0	121.4	97.0	187.5	163.3
25–30	101.3	65.2	85.0	102.5	241.4	190.5
30–35	123.9	64.2	84.5	77.2	158.7	168.3
35–40	99.0	66.8	94.4	73.5	195.8	104.3
40–45	110.7	49.3	86.8	70.8	176.1	83.9
45–50	74.8	53.4	105.0	59.8	210.0	81.3
50–55	67.4	44.0	94.8	45.6	137.7	55.2
55–60	69.1	34.0	81.2	40.3	139.3	53.0
60–65	39.7	30.4	87.4	40.8	90.9	43.4
65–70	31.8	18.8	60.4	29.3	54.7	37.8
70–75	29.7	24.1	45.9	23.1	59.2	32.9

*Münch. med. Woch., 1889, No. 43.
†Louisville Medical News, March 22, 1884.
‡La Tuberculose en Belgique, Brussels, 1889.

This table shows a greater death-rate among the married than single, and also that there is a very high death-rate from tuberculosis among the widows and widowers. The suggestion is very strong that the latter class catch the disease from their mates, and later follow them to the grave. The increase among the married is difficult to explain, since it is chiefly confined to the men. Infection from the mild and recovering cases will explain the rise in part, but apparently in part only. The bad result among widows and widowers cannot be explained by reference to the vicissitudes of this state, since it shows in both sexes, while widows alone are specially exposed to want; and this is fully counterbalanced by the want among that numerous class, the prostitutes.

Ransome's* and Flick's† figures, showing that deaths from tuberculosis tend to occur in certain houses, strongly suggest indirect infection. The same is true of the marked tendency of the disease to annihilate certain families.

As negative evidence in the same line, we have many illustrations of how care and cleanliness will cut down a high death-rate from tuberculosis, as in modern reformed prisons, or even avoid the disease. Thus, Stick, ‡ in Neuronberg, has had during eight years, but one case of tuberculosis in an orphan asylum with an average of one hundred inmates. The one case came in diseased and was promptly discharged as dangerous.

Objections can be raised to all these figures. Against Cornet's and similar cases it has been objected that the increased amount of tuberculosis was due, not to increased infection, but to the hardships of their conditions. No such objection can be raised where isolation has prevented further infection, nor are the conditions of European soldiers or criminals worse during time of service or confinement than when at large.

Animals afford valuable information in many ways.

The first thing of note is the great variation in the amount of tuberculosis. While in confinement the disease may

*British Medical, 1891, vol. i, p. 463.
†Times and Register, Philadelphia, 1839, xx, p. 97.
‡Deutsch. Archiv. f. klin. Med., Bd. 42, 1887, p. 219.

appear in any mammal, and even in snakes and other cold-blooded creatures; it is, under usual conditions, confined to domestic animals. I say nothing of hens, since it is not at all clear that hen tuberculosis is the same as human; indeed, the evidence is fairly conclusive that in most cases it is not. Many cases are recorded where hens ate sputa and later developed tuberculosis; but when we isolate and so feed them the results are negative; when inoculated the same is most always the case. And, finally, the cultures from hens are allowed to be different by no less an authority than Koch. Personally, some years ago I fed quantities of sputa to hens and pigeons, and injected it by the syringeful, with no resulting tuberculosis.

Tuberculosis, though spontaneous among all domestic animals, is most common in cattle, then swine, then the others with much smaller numbers. Some speak of it as almost unknown in horses and dogs; this is not the case.

In cattle the amount of tuberculosis increases steadily with the age, and is also much influenced by sex. Thus, of 1,133,195 calves, 71 were tuberculous; of 1,958,132 grown-up cattle of all sorts, 25,163 (1.2 per cent) were tuberculous; that is, the prevalence of tuberculosis in calves as compared to cattle, is as 1 : 300. Few have given finer classifications. Goring* gives a per mille calculation, based on the reports of the inspectors of all cattle in Bavaria.

One thousand	bulls	5.84 per cent.
"	bullocks	1.34 "
"	cows	2.50 "
"	heifers	0.35 "
"	calves	0.09 "

Again, tuberculosis was distributed as follows:

Less than 1 year,	in 1877, 64 (1.31 per ct.),	in 1878. 65 (1.30 per ct.)
1 to 3 years old,	" 328 (10.81 per ct.),	" 551 (1.20 per ct.)
3 to 6 years old,	" 1,846 (37.80 per ct.),	" 1,730 (34.50 per ct.)
Over 6 years old,	" 2,445 (50.07 per ct.),	" 2,360 (46.50 per ct.)

*Propagation of Tuberculosis, by Lydten, Fleming, and von Hertsen; Woch. f. Theirheilte., 89, No. 9; Am. Vet. Journal, January, 1889, and May, 1890.

It is to be noted here that calves are those saved for cattle, and include much older ones than those slaughtered for veal.

At Augsburg, 24,766 veal calves, with one case of tuberculosis, and 13,193 cattle, with 512 (3.95 per cent), were slaughtered.

Strobl and Magen* give, for Münich in 1879, 1,125 cases of tuberculosis (or 2.5 per cent) divided as follows:

Under one year.	2 or	0.2 per cent.
One to three years	81 or	7.2 "
Three to six years	378 or	33.5 "
Over six years	664 or	59.2 "

From the "Veterinary Journal," from the German:

11,227 oxen, with	51 cases.
1,657 steers, with	8 "
1,389 cows, with	45 "
598 yearlings, with	3 "
30,477 calves, with	1 "

Again:

23,592 calves, with . .	1 case.	
8,537 oxen, with . .	167 cases,	or 1.94 per cent.
5,008 cows, with . .	445 "	or 8.88 "

The figures are not very numerous, but show clearly that the increase of tuberculosis in cattle with age, as insisted upon by all European inspectors, is correct. Goring's figures have a special interest, in that the bullocks and bulls show a much higher rate than the heifers or even cows. Yet the males consume no more milk than the females, but they are kept in much closer quarters—that is, much more exposed to dust infection. Sows and hogs which are kept together show no such difference. As a whole, the figures show a constant increase in tuberculosis with age, precisely what must result with a steady source of infection, and a chronic disease, and not at all the result where food during youth is the chief source of infection.

*Ibid.

The figures of Bayard,* showing that the curves of tuberculosis in cattle and man follow each other closely all through Baden and Bavaria, are of interest. The case is cited to show the dependence of human tuberculosis on that of cattle. It would be just as reasonable to argue the other way. If men catch tuberculosis from eating the cattle, where do the cows get it from — eating each other? The proper place to look for the cause is in ways common to both — that is, indirect infection, not food.

In studying death-rates, it is to be noticed that from about the fifth to the twentieth year there is a marked diminution of the death-rate; or that there is a short high wave during the first five years; and another, with a sharp rise followed by a slow, steady increase, extending from the commencement of adult life to old age.

Some might hold that the first wave was due to infected milk, since there is some relation in time between the consumption of milk and the high death-rate. This requires a rather long step to a conclusion. The early years of life are noted for their great mortality from all sorts of causes — that is, young children are very vulnerable. During the first part of life tuberculosis spreads, becomes general with great rapidity, and immediately after develops a marked predilection for the nervous system. These are conditions peculiar to the age, not to the source of infection. The conditions of life during this period are also such as to offer very good opportunities for indirect infection. First, it is the period of closest personal contact, kissing and cosseting. Next, it is the period of life during which the head is in the sediment of the atmosphere. Young children live on the floor, older people on their feet or furniture. It is also the period of house-dwelling and bronchial troubles.

Can we conclude from the result of an autopsy, where the bacillus gained entrance to the body? There is no primary lesion as in syphilis, but is there of necessity any lesion at site of entrance? Apparently not, as shown by the numerous

*Archiv. f. wissnschft u. prakt. Theirhielk., xv, 89, p. 1.

class of bone, joint, and lymphatic tuberculosis, with healthy lungs, intestine, and skin. Our only hope, then, is to demonstrate that the lymphatic behind the site of entrance becomes tuberculous, while the others do not, or at least to a much less degree, if we are to accept autopsy statistics as usually gathered. This is partly true, partly not, and least of all in regard to the glands which interest us most, those of the mesentery and the lungs. Either, indeed both, sets of glands are often attacked without their organs being affected. More in fœtal tuberculosis, where the bacillus has entered through the cord, both sets of glands may form the chief lesion. In other words, the initial lesions are very apt to be concealed before death, owing to the generalization of the disease and its predilection for certain organs. Lump figures, therefore, are of little value. They show, however, two points of interest: first, in spite of all the sputa swallowed, intestinal tuberculosis is less frequent than pulmonary; second, the large amount of lymphatic tuberculosis in the young.

Though we cannot advance far with figures in the mass, still quite a number of cases justify the pathologists in selecting the point of entrance. Thus Grawitz, in one hundred and ninety-seven cases, classed one hundred and fifty-two as primary in the lungs, nine primary in the intestines, two or three as external, and the rest as unknown. Biediert, in 1884, could only find thirty cases of primary intestinal tuberculosis reported in the literature.

The statistics from cattle killed before the disease has come to an end avoid most of the difficulties inherent in autopsies; the initial lesion is not so much hidden. Thus Goring gives the result of 1,596 cases as follows:

Lungs alone infected	21 per cent.
Pleura and peritoneum only	28 "
Pulmonary and pleural only	39 "
Generalized	9 "
Genital lesion only	3 "

Unfortunately, I have been unable to find other similar tables; but it is evident from reading reports that the above

represent the combinations usually found. These, it will be noted, take no account of the intestine.

The cases of latent tuberculosis in man offer similar conditions to the slaughtered cattle. The disease has not spread. Where do we find these deposits? In the lungs. Kurlow* gives a table taken from the reports of several pathologists who have especially studied this subject. It is given below, with a few additions. All ordinary tuberculosis is excluded so that the figures show the proportion of latent or cured tuberculosis in those dead of other disease.

Rogee .	. 100 old women.	Scars in the apices of	. 51
Dejerine	. 100 "	" " "	. 51
Royer .	. 160 autopsies.	" " "	. 157
Bollingér	. 259 "	" " "	. 69
Staudacher	. 787 "	" " "	. 202
Massini	. 228 "	" " "	. 89
Vibert†	. 131 violent deaths.	" " "	. 25
	1,765 cira.		644

These figures agree closely with the results in cattle, and clearly indicate a large mass of primary lung — that is, indirect — infection.

In view of all these data — the observations on cattle, the seat of latent tuberculosis, and the like — it is clear that indirect infection plays a prominent part in the spread of tuberculosis. It is to be noted that the observations including large numbers all point to this. I therefore feel justified in summarizing as follows:

It is clear that a certain amount of indirect inoculation occurs.

It is highly probable that a larger amount of indirect inoculation takes place, as in skin tuberculosis, scrofula. Of this I have adduced no evidence.

Evidence is not in favor of flesh, after passing inspection, being a factor of any import.

*Deutsche. Archiv. f. klin. Med., xliv, p. 438.
†Centralbl. f. Bact. u. Parasit., Bd. iv, p. 519.

Milk is clearly a source of danger, though, judging from the data at large, not a considerable one.

Indirect infection is probably the chief mode of infection, the bacilli entering through the lungs, the skin, and the alimentary tract, with but few exceptions.

The application of these conclusions is very clear: the inspection of food should be kept up as at present. People keeping private cows should be taught to be cautious of those which cough, and milkers' herds should be watched. To offset indirect infection, the State should see to it that the rooms occupied by phthisical patients are properly cleansed. At the time of the millenium people may always cough on handkerchiefs, keep their hands free from sputa, and always spit into improved cups, rather than on the floor; but at present they will not. The wealthy, who have more or less followed these rules for a long time, are relatively exempt from tuberculosis.

The one sure and ready way to kill a tubercle bacillus is to cook it hard for at least fifteen minutes; antiseptics are not safe in the people's hands. All infected clothing should be boiled before handling, not tucked away in a bag, then shaken out, counted, and washed. Everything coughed up should be spit into special cups, and thoroughly steamed before emptying and washing. Patients should not cough all over the room, but hold a handkerchief before the mouth. All rooms liable to infection should be carefully cleaned, especially the floors, furniture, and first six feet of the walls. For this we must rely on washing, out-door beating and dusting, and antiseptic solutions. The best antiseptic is carbolic acid, the stronger the better (never less than one per cent) applied long enough to soak in thoroughly.

At some future time people may wake up to the conditions of the case, and demand walls and floors both smooth and washable, and the banishment of the dust-traps called modern furniture, provided they do not demand a certain degree of isolation of the phthisical and the systematic destruction of all tuberculous cattle.

In closing, I would disavow all ideas of having exhausted the subject or of having demonstrated the proof of more than a few points at most. The subject is a most difficult one. We want more careful and extended studies on the occurrence of the tubercle bacilli, on the effects of administering small numbers of the same, on the probable sources of infection in individual cases, and on the course of the disease as indicative of the source and time of infection.

THE PREVENTION AND DESTRUCTION OF PHTHISIS.

In a former report of this board we summarized upon this disease as follows:

1. Pulmonary phthisis is the most fatal disease known to civilization.

2. The *bacillus tuberculosis* is generally believed to be the cause of the disease.

3. The disease, when developed after the first years of childhood, is acquired and not inherited, although there may be an inherited predisposition which renders the subject incapable of resisting the invasion of the bacilli.

4. The disease is liable to appear at any period of life.

5. That there is great danger arising from the use of tuberculous meat and milk. From the evidence which has been gathered, we are led to believe that the liability to infection from these sources is very great, and to insure public protection in this particular, the State should exercise a careful supervision of our milk and meat supplies.

6. That the greatest danger of infection is from the sputa of the consumptive. For this reason, when confined to the house, a spit-cup or spittoon should be used, and when upon the street a handkerchief to receive the expectorations. The spit-cup and spittoon might preferably contain a disinfectant, but if these vessels are frequently and thoroughly cleansed with boiling water, disinfectants are not an absolute necessity. The handkerchiefs used should be immersed in boiling water at least daily, before the sputum has become dried.

7. No person should occupy a sleeping-room with another

who has tuberculosis, although many persons escape infection under such conditions.

8. The eating utensils of a consumptive should be washed in boiling water, and care should be exercised that the same glasses, spoons, etc., are not, before being washed, used by children and others. The patient should also avoid kissing others or placing in his mouth any article likely to be used or handled by others.

9. The dejections of consumptive patients, in cases where the bowels are affected, should be thoroughly disinfected.

10. Perfect cleanliness of the apartments occupied by consumptives should be urged in all cases. The bed linen, towels, etc., should be very frequently put through the operations of the laundry, while the walls should be frequently cleansed and dressed anew. In fact, the whole question of restriction may be expressed in the one word "cleanliness."

A. Arnold Clark in discussing the question of restricting consumption says: *

Every person, after coughing a month or so and raising sputa, should, for his own comfort and the public safety, have a microscopical examination of the sputa to make sure whether it contains the germs of consumption.

No consumptive should be allowed to expectorate on the floor or street.

Cuspidors in hotels and other public places should be partly filled with water. They should be washed twice a day in boiling water, and the contents should be disinfected with a solution of bichloride of mercury.

Where there are no cuspidors, sputa should be received on cloths, which should be placed in an envelope for the purpose and afterwards burned.

All sputa from consumptives should be disinfected or burned.

No person should sleep in the same room with a consumptive patient or in a room which has been occupied by a consumptive, unless the room has been previously disinfected with the fumes of burning sulphur.

The floors, walls, and furniture of a room occupied by a consumptive should frequently be thoroughly cleansed.

* From proceedings of sanitary convention at Pontiac, Mich.

The clothing of consumptive patients should not be washed with other clothing.

Milk from an unknown or suspicious source should be heated to the boiling point before use.

Meat from animals affected with tuberculosis should be destroyed, and all meat from an unknown source should be thoroughly cooked.

Everyone should sleep in a well ventilated room, and take some active physical exercise each day. This precaution should be taken especially by consumptives, and if the employment is in doors it should be changed, if possible, for some out-door occupation.

In a paper read before the New Hampshire Medical Society at its last meeting, by Dr. Arthur K. Day, he said:

In view of the infectious nature of tuberculosis, and the demonstrated presence of its germs in the sputa, measures to prevent the spread of the disease are rationally directed towards destroying these germs. For this purpose, the chemical disinfectants in ordinary use have proved inefficient, and the most effective germicide is heat. As the moisture of sputa holds the bacilli, and prevents their dissemination through the air, it is important to destroy them before drying has occurred. An efficient aid to this is the use of paste-board sputa cups, costing but little, which may be burned as soon as filled. All porcelain or metal cuspidors must be cleaned thoroughly with boiling water, at least daily. Cloths, used as receptacles for sputa, should be immediately burned, or immersed in boiling water. If these measures are carried out, the danger of communicating the disease will be reduced to a minimum, the isolation of tuberculous patients, recommended by some authorities, rendered unnecessary, and the safety of the public quite as well secured as though the patient were subjected to further privations than his disease inevitably imposes upon him.

Assuming as a fundamental principle that the aim of all therapeutic measures is, to relieve suffering or to prolong life, or both, let us consider the circumstances in which we shall place our patient in order to fulfill most completely these indications. Foremost comes the question, "Where shall our patient reside in order to have the best chance of recovery?" Careful analysis of several thousand cases shows that a dry, elevated altitude is about three times as favorable to recovery as a low one. And those cases do best which take advantage

of altitude in the early stages of the disease before much constitutional disturbance appears. Unfortunately, however, the circumstances of the vast majority of patients forbid so radical a change as removal to another climate, and they must be treated at their homes. Therefore, although fully recognizing the advantages obtained by change of climate, I shall dwell more particularly upon the treatment which the patient may receive at home.

Manifestly, hygienic conditions should be as favorable as possible. Dwellings well ventilated, well warmed, and with an abundant supply of sunlight are, fortunately, within the reach of the greater portion of New Hampshire's residents, at least, and are essential to the favorable progress of our patients. They must be encouraged to spend as much time as possible in the open air, in good weather, and will find this a most efficient aid to recovery. If the consumptive's occupation is such as to keep him in doors a great part of the time, a change in this respect is desirable, and in the greater number of cases, it is possible to obtain some business better suited to his condition.

Of no less importance is the patient's diet. He must be well nourished, and should receive definite directions as to the amount of food to be taken. Milk in large quantity, two or three quarts daily, can be borne well by most consumptives, even when the appetite is poor. If it is not well assimilated, other foods must, of course, be selected, and a liberal amount of meats, fats, and farinaceous articles is to be prescribed. As long as the appetite is good, the taste of the patient may determine the diet, provided only the amount is sufficient. But the appetite failing, a prescribed dietary is to be insisted upon.

The state board of health of Pennsylvania in a circular on precautions against consumption says:

This fatal scourge seeks its victims by preference from persons in the prime of life. The father, the bread-winner, for the little brood growing up around him, the young mother, with a babe at her bosom, these are the valuable lives which succumb most readily to its insidious advances. Could its ravages be stayed what immense periods would be added to human existence! How great would be the addition to the wealth of the State! What an untold sum of suffering and misery would be eliminated from the history of daily life! Recent discoveries and experiments lead us to hope that such

a result may be measurably obtained. This hope depends upon the now thoroughly established facts, that in every case of consumption there is present in the lung a minute organism or germ of the kind known as bacillus, hence called the Bacillus of Tuberculosis, and that the introduction of this organism into the system will produce consumption. Hence the inference that if we can keep this bacillus out of the lungs in any given case, we shall prevent that individual from having consumption. It becomes, therefore, of the utmost importance that we should understand how the disease is spread or acquired; in other words, how the bacillus finds its way into the system. It may enter through the stomach, in consequence of the flesh or milk of animals having the disease, being used as food. This source is comparatively rare, and, as prolonged high temperature kills the germ, if we cook our food thoroughly we shall run no risk of becoming infected in this way. The grand source of danger which we have to guard against is the expectoration of the consumptive, the matter coughed up from the diseased lung, the spit (called by physicians the sputum, plural sputa). This expectoration swarms with these microscopic organisms. Their tenacity of life is very great, and as long as they retain life they are capable of reproducing their kind in the lungs of a healthy person. Drying does not in the least impair their vitality. When the expectoration dries, it rapidly becomes pulverized, and then these germs float about as fine, invisible dust in the air.

So long as the bacillus itself remains moist, and in contact with a moist surface, the danger of its finding its way into the air is extremely small. The surface of the air-tubes and air-cells of the lungs being always moist, there is, therefore, little probability that the bacilli will pass out in the breath of the patient. It follows from this that if the precautions hereinafter suggested are carefully observed, no one need feel the least anxiety in nursing a consumptive, even in the last stages of the disease.

PRECAUTIONS WITH REGARD TO CATTLE.

1. There should be a most rigid system of inspection of cattle and meat under competent authority.

2. Such laws should be enacted as would secure the infliction upon persons who knowingly sell tuberculous meat or milk, of penalties equally severe with those which are imposed for any other form of intentional or careless poisoning of their fellow men.

3. Tubercular cattle ought to be killed at once, and their carcases burned with rosin or tar. Pecuniary losses which individuals might thus suffer, are not worthy of a moment's consideration when compared with the evil which may thus be prevented. It would pay the State well, however, to compensate them.

4. When it is necessary to feed infants with cow's milk, it should always be thoroughly boiled; and in fact it would be well for older persons to avoid the use of raw milk unless they are perfectly certain that it comes from a healthy herd.

PRECAUTIONS TO BE TAKEN BY THOSE WHO ARE PREDISPOSED TO CONSUMPTION.

Those who inherit a predisposition to consumption, or who have been informed by their physicians that they have weak lungs, should avoid —

1. Living in a damp situation, a damp house, or a house with a damp or foul cellar.
2. Frequenting crowded and ill ventilated assembly rooms.
3. Sleeping in ill ventilated apartments.
4. Sedentary occupations within doors.

Such persons should always endeavor to obtain a sunny room. The one grand preventive, however, is living in the open air. Southern climates are beneficial in the early stages of the disease, simply because they afford an opportunity for open air life, not because there is anything curative in the warmth. The children of consumptives should, therefore, be brought up, if possible, in the country. Their education should be shaped with reference to the adoption of an avocation which will compel them to live much out of doors, and their tastes should be trained in the same direction. If, notwithstanding these precautions, they exhibit a lack of vigor and a tendency to weakness of the chest as they come to maturity, it would be well for them to select as their permanent abode some region which is celebrated for its freedom from this disease; such as the Adirondacks, Colorado, Florida, New Mexico, or the sub-tropical islands of the Atlantic ocean. This is far more rational, and no whit more distressing than seeking those climates when the lungs have become seriously affected, in the too often vain and illusory hope of healing them. The food of such persons, as well as of actual consumptives, should be abundant and nourishing, and milk and cream should be freely used, with the precautions already suggested.

Consumptives should never house themselves on account of the weather. They should be warmly clad, with woolen next the skin, and then make it a duty to go out in all weathers and temperatures.

PRECAUTIONS TO BE OBSERVED BY THE PATIENT.

Painful as the conviction that he is liable to be a dangerous source of infection to his family and friends, as well as to the public, must be to the sufferer from phthisis, it must be forced upon him. This is the duty of his medical adviser. In any case where a patient presents himself with a persistent cough accompanied by expectoration, unless the physician feels absolutely sure from the physical signs that the case is one of consumption, he should make or procure a microscopic examination of the sputa.

What the patient must see to is that under no circumstances shall his expectoration be allowed to dry before it is destroyed, or placed where it can by no possibility be a source of danger. To this end he must scrupulously avoid spitting on his handkerchief, on the floor, or on the ground. When away from his home he should carry with him a small flask containing a small quantity of five per cent solution of carbolic acid or corrosive sublimate, a grain to the pint, or some other disinfectant. At the last meeting of the American Public Health Association a flask was exhibited designed for this express purpose, having a movable cover on each end, in order to allow of its being thoroughly cleansed. In the house it would be well to use a small paper cup, which should be set inside a china or metallic cup, the latter containing a disinfectant solution which should moisten the bottom of the former. This paper cup should be burned, or otherwise safely disposed of, at least once a day; if the expectoration is considerable, much oftener. A simple substitute for such a cup can be easily made by rolling two or three thicknesses of newspaper into a cone, nicking the open end, and folding it over the edge of the outside receptacle. Care must of course be taken that the sputa do not become dry upon the paper. If a spittoon is used it should always contain water, with the addition of a disinfectant, and should be of such shape that the sputa may fall directly into the water without resting on the sides of the vessel. All such receptacles should be frequently emptied and cleansed with boiling water and potash soap. The contents should never be thrown upon the surface of the ground, or where domestic animals can get at it. The

ordinary wooden spit-box filled with sand or sawdust, so often found in public houses, is very objectionable, and should at once be banished. If a patient is so extremely ill as to be compelled to use a handkerchief or cloth, these should either be burned or soaked for several hours in a five per cent solution of carbolic acid, and then boiled and washed.

A consumptive mother should on no account nurse her own infant. While, as already stated, the breath of the patient is not a germ-carrier, yet it will be readily understood how disease might be transmitted by kissing upon the mouth.

PRECAUTIONS TO BE TAKEN IN THE SICK ROOM.

The duster, and especially that potent distributor of germs, the feather duster, should never be used in the room habitually occupied by a consumptive. The floor, woodwork, and furniture should be wiped with a damp cloth. The patient's clothing should be kept by itself, and thoroughly boiled when washed. It need hardly be said that the room should be ventilated as thoroughly as is consistent with the maintenance of a proper temperature.

PRECAUTIONS TO BE TAKEN AFTER THE DEATH OF A PATIENT.

When a death has occurred from this disease, the patient's clothing and bed clothing should be boiled or disinfected by super-heated steam. The woodwork, furniture, walls, and floor should be washed with a disinfectant solution of either carbolic acid or corrosive sublimate. If the walls are covered with ordinary paper it should first be wet with a disinfectant solution, and then scraped off while wet. An abundance of fresh air and sunshine should then be admitted for several days.

PRECAUTIONS TO BE TAKEN BY THE PROPRIETORS OF PUBLIC HOUSES AND PUBLIC CONVEYANCES.

Every public house, hotel, hall, place of amusement, steamboat, or railroad car should be well supplied with metallic or china spittoons, in which a disinfectant solution, which need not necessarily have an odor, should be constantly kept. Proprietors of sanitaria which are frequented by consumptives need to exercise special care in regard to their rooms. It would be well that steamship and railroad companies should furnish separate accommodations for persons thus affected, which appartments should be kept scrupulously clean, in accordance with the preceding suggestions.

OBSERVATIONS UPON SOME OF THE CAUSES OF DEATH IN NEW HAMPSHIRE.

The desire to emphasize the fact which has heretofore been stated by this board, that an accurate record of the causes of death constitutes the only guide or measure by which the results of sanitary work can be definitely determined; it also as effectually points out those localities to which the attention of the health officer should be turned for active work to lessen an abnormally large death-rate. Were it possible to secure the return of every case of illness that appears in the State we would have an absolutely correct criterion upon which to base all calculations respecting sanitary work. Such a record, however, under the present conditions of social, moral, and legal government is not attainable, therefore, the next best information, which, thanks to the progressive spirit of the people of the State, we are in possession of, is a reliable and approximately correct record of deaths. We would be more fortunate if this record covered a longer period. It is only within the past seven years that the death returns have been sufficiently accurate for making deductions respecting the prevalence of certain diseases, yet the facts that have been established from the mortality records of this brief period are invaluable from a public health standpoint, not to mention the importance of the individual records in matters pertaining to person and property.

In the following pages will be found a brief summary of the causes of death, with comments necessary to a better understanding of the tables presented. Those desiring to study this subject more in detail should consult the registration reports. In these reports will be found the mortality record of every town in the State.

The total number of deaths returned to the registrar of vital statistics for the year ending December 31, 1891, was 7,310. This is fifty-eight less than was returned for the year 1890, but six hundred and nineteen more than the average for the past eight years. This excess over the average for

the years stated is not due wholly to an actual increase in the death-rate, but to a more complete registration than existed during the earlier years of the period embraced in the comparison. Nevertheless that there has been an actual increase in the death-rate during the past two years, from epidemic influenza, or "La Grippe," is a fact fully demonstrated by the records. In 1889 there were but four deaths from this malady; in 1890 there were ninety-four, and in 1891 *one hundred and forty-three*. This increase does not by any means represent the total mortality that should really be credited to this disease, inasmuch as it is accountable for increasing the mortality of other diseases, like pneumonia, bronchitis, etc.

TABLE No. 1.

Deaths and Death-rates, from 1884 *to* 1891, *inclusive.*

YEARS.	Deaths registered.	Deaths to 1,000 of population.*
1884	6,194	16.26
1885	6,201	17.13
1886	6,426	17.61
1887	6,479	17.61
1888	6,854	18.48
1889	6,696	17.91
1890	7,368	19.56
1891	7,310	19.41
Average	6,691	.....

* Population estimated for all but census years.

Table No. 1 gives the number of deaths returned for each year from 1884 to 1891, inclusive, with percentage to each 1,000 of the population. We stated in our last report that a death-rate of 18 — possibly a fraction over — we believe to be the average per 1,000 of the population for New Hampshire, a rate probably as low as can be found in any State in the Union, and considerably below that of some of the States. By this we do not mean to assert that New Hampshire is naturally more healthful than some other States with a higher death-rate, for in the consideration of this subject, nationality, social conditions, occupations, environments, and many other conditions must be taken into account. The average death-rate for Europe from 1865 to 1883 was 28.1 per 1,000 of the population; for Europe, excluding Russia, it was 25.8; and for Russia alone, 35.7. For Eastern Europe, 35.7; Central Europe, 28.3; Southern Europe, 25.6; Northwestern Europe, 20.5. Massachusetts for a period of thirty years ending in 1888, had a mortality rate of 19.48; Austria for thirteen years ending in 1883, 31.0; and for about the same period the death-rate of Greece was 20.8; Denmark, 19.7; Sweden, 18.9; Ireland, 17.8; and Norway, 17.2. In our own country those States which have a reliable system of registration have a death-rate ranging from about 18 to 20 per 1,000 of the population. We can, therefore, upon the basis of our mortality records safely assert that New Hampshire is as healthful a State as any in the Union.

Table No. 2 shows the number of deaths and the death-rate per 1,000 of the population, by counties, for the years 1884 to 1891, inclusive. The highest death-rate has usually been in Hillsborough county, while the lowest, as a rule, has been in Coös; but in 1891, the highest rate was in Strafford county, and the lowest in Sullivan. The death-rate for the year by counties is as follows: Rockingham, 19.95; Strafford, 21.04; Belknap, 19.29; Carroll, 18.81; Merrimack, 19.23; Hillsborough, 20.98; Cheshire, 16.29; Sullivan, 16.18; Grafton, 17.41; Coös, 19.77.

The rate for the entire State is 19.41 per 1,000 of the population.

TABLE No. 2.

Death and Death-rates, by Counties, from 1884 *to* 1891, *inclusive.**

COUNTIES.	1884.		1885.		1886.		1887.		1888.		1889.		1890.		1891.	
	Deaths.	Death-rates.	Deaths.	Death-rates.	Deaths.	Death-rates.	Deaths.	Death-rates.	Deaths.	Death-rates.	Deaths.	Death-rates.	Deaths.	Death-rates.	Deaths.	Death-rates.
Rockingham	873	17.69	911	18.43	963	19.46	876	17.67	896	18.05	875	17.61	1,065	21.45	991	19.95
Strafford	627	17.07	619	16.73	609	16.33	673	17.91	688	18.17	691	18.11	801	20.83	809	21.04
Belknap	285	15.09	289	15.12	362	18.71	369	18.84	392	19.78	389	19.40	374	18.40	392	19.29
Carroll	333	18.31	269	14.80	303	16.68	294	16.20	328	18.08	298	16.44	303	16.71	341	18.81
Merrimack	736	15.48	796	16.63	833	17.29	835	17.22	920	18.86	891	18.15	983	19.88	951	19.23
Hillsborough	1,655	20.02	1,701	20.15	1,681	19.51	1,697	19.38	1,846	20.59	1,740	19.04	1,973	21.14	1,957	20.98
Cheshire	497	17.06	494	16.90	475	16.19	482	16.39	488	16.52	525	17.72	557	18.49	482	16.29
Sullivan	273	15.32	284	16.02	328	18.59	283	16.12	327	18.72	314	18.06	332	19.81	280	16.18
Grafton	652	17.06	611	16.05	616	16.24	602	15.93	655	17.35	625	16.67	651	17.49	648	17.41
Coös	263	12.88	227	10.87	256	12.00	368	16.89	314	14.11	348	15.32	329	14.17	459	19.77
Total	6,194	17.26	6,201	17.13	6,426	17.61	6,479	17.61	6,854	18.48	6,696	17.91	7,368	19.56	7,310	19.41

* Population estimated for all but census years.

TABLE No. 3.

Percentages of Deaths, by Quarters, from 1884 *to* 1891, *inclusive.**

YEARS.	PERCENTAGES OF DEATHS FOR QUARTERS ENDING WITH			
	March.	June.	September.	December.
1884	23.23	23.40	26.63	26.74
1885	27.27	26.66	24.32	21.75
1886	23.75	23.27	28.90	24.08
1887	24.56	24.02	27.77	23.65
1888	25.94	23.72	26.82	23.52
1889	23.70	24.16	27.38	24.76
1890	28.82	21.63	26.71	22.84
1891	22.36	24.15	26.89	26.58

* Not including deaths with month not stated, premature and still births.

Table No. 3 shows the percentages of deaths, by quarters, from 1884 to 1891, inclusive. It will be noticed that the greatest mortality usually occurs during the quarter ending with September, while for the other three quarters it is more nearly uniform. The increased rate recorded for the third quarter of the year is doubtless due to cholera infantum, which is most prevalent during July, August, and September.

The rate for the first quarter for the year 1891 is 22.36 of the total monthly; for the second quarter, 24.15; third quarter, 26.89; fourth quarter, 26.58.

TABLE No. 4.

Mortality of Males and Females compared, 1884 to 1891, inclusive.

YEARS.	Male decedents.	Female decedents.	Male decedents to 100 female decedents.	Death-rate of males to 1,000 male population.	Death-rate of females to 1,000 of female population.
1884	3,034	3,122	97.18	17.79	17.69
1885	2,948	3,194	92.29	17.28	18.09
1886	3,155	3,212	98.20	18.50	18.20
1887	3,174	3,267	97.15	18.61	18.51
1888	3,419	3,382	101.09	20.04	19.16
1889	3,253	3,389	59.88	19.07	19.20
1890	3,692	3,624	101.87	21.65	20.53
1891	3,557	3,453	102.72	19.60	17.65
Average	3,279	3,330	98.31	19.07	18.63

Table No. 4 exhibits the mortality of males and females compared for the years 1884 to 1891, inclusive. With the exception of the years 1888, 1890, and 1891, the female decedents have exceeded the males. By a comparison of the death-rates of the respective sexes to each 1,000 of the living population of that sex, it will be seen that the average mortality rate of the male population is slightly higher than that of the female.

In 1891, 3,557 male decedents and 3,453 female decedents were reported.

The death-rate of males to each 1,000 of the male population was 19.07.

The death-rate of females to each 1,000 of the female population was 18.65.

TABLE No. 5.

Deaths at Age Periods by Percentages, from 1883 *to* 1891, *inclusive.**

YEARS.	Under 1.	1 to 5.	5 to 10.	10 to 20.	20 to 30.	30 to 40.	40 to 50.	50 to 60.	Over 60.
1883	14.13	7.58	2.56	5.55	8.58	6.73	6.22	7.64	37.93
1884	16.22	7.36	2.61	5.30	7.93	6.26	6.33	7.75	38.38
1885	15.98	7.14	2.11	4.42	7.50	6.71	6.71	7.76	40.09
1886	16.89	7.70	2.86	4.82	7.73	6.55	6.12	7.47	38.86
1887	17.64	7.26	2.05	4.89	6.96	6.25	6.56	7.72	39.70
1888	19.23	7.63	2.04	4.93	7.07	6.00	5.53	7.57	38.72
1889	19.44	7.71	2.66	4.64	6.56	6.15	5.93	7.63	38.40
1890	16.23	6.67	1.99	4.28	7.04	2.12	6.62	9.17	40.49
1891	18.30	7.08	2.55	4.40	6.95	6.01	6.29	8.15	40.25

* Not including those with age not stated, premature, and still births.

Table No. 5 shows the deaths at age periods by percentages from 1883 to 1891, inclusive.

This table is interesting in showing how uniformly the percentages are maintained for a certain age period from year to year, thus giving one of many proofs that the factors which bear upon the mortality of a State are governed by well defined laws.

TABLE No. 6.

Deaths at Different Periods, compared with the number Living at the Same Period, 1891.*

	Deaths, 1891.	Persons living at same ages, census of 1890.	Death-rate per 1,000.
Under 1 year	1,264	6,141	205.82
Under 5 years	1,753	30,573	57.34
20 to 30 years	480	63,252	7.71
All others	4,791	253,166	18.90
All ages	7,024	376,530 †	18.65

* Excluding still births and premature births. † Census of 1890.

Table No. 6 exhibits the number of deaths at different age periods compared with the number living at the same period, based upon the census of 1880, with the exception noted in the table. This table shows a death-rate per 1,000 of the population under one year of age, of 205.82 as against 186.61 for the preceding year; and under five years of age, 57.34 as against 52.79 for 1890; between twenty and thirty, 7.71 in 1891, and 7.77 in 1890 — practically the same; all others, 18.90 in 1891, and 19.74 in 1890; for all ages the rate was 18.65 in 1891, and 18.87 the preceding year.

The difference in the death-rate between table No. 1 (19.41) and that of table No. 6 (18.65) is due to the exclusion of still births and premature births from the latter, while the former includes both.

TABLE No. 7.

Deaths by Ages and Sex, from 1884 *to* 1891, *inclusive.**

YEARS.		Under 1.	1 to 5.	5 to 10.	10 to 20.	20 to 30.	30 to 40.	40 to 50.	50 to 60.	60 to 70.	70 to 80.	80 to 90.	90 to 100.	Over 100.	Unknown.
1884..	Males	460	243	72	136	224	168	180	245	322	502	292	30	1	60
	Females	353	212	90	192	266	220	211	235	336	444	379	70	...	51
	Not stated	3	1	...	...	1	...	1	...	1	...	...	...	...	4
	Total	816	456	162	328	491	388	392	480	659	946	671	100	1	115
1885..	Males	416	225	62	109	190	181	190	252	394	478	284	32	1	43
	Females	371	217	68	164	275	235	226	225	355	463	398	74	2	50
	Not stated	18	1	1	1	...	...	...	4	2	3	...	...	...	5
	Total	805	443	131	274	465	416	416	481	751	944	682	106	3	98
1886..	Males	487	273	94	132	205	188	198	228	368	499	317	42	2	33
	Females	385	221	90	178	292	233	195	252	339	447	397	83	3	28
	Not stated	19	1	...	...	...	...	...	...	...	...	...	...	...	3
	Total	891	495	184	310	497	421	393	480	707	946	714	125	5	64
1887..	Males	490	231	71	142	196	184	186	254	377	512	336	45	1	34
	Females	416	239	61	175	255	221	239	246	358	494	350	93	6	28
	Not stated	8	...	1	...	...	...	...	...	...	...	...	...	...	1
	Total	914	470	133	317	451	405	425	500	735	1,006	686	138	7	63

* Excluding still births and premature births.

TABLE No. 7. — *Continued.**

Deaths by Ages and Sex, from 1884 *to* 1891, *inclusive.*

YEARS.		Under 1.	1 to 5.	5 to 10.	10 to 20.	20 to 30.	30 to 40.	40 to 50.	50 to 60.	60 to 70.	70 to 80.	80 to 90.	90 to 100.	Over 100.	Unknown.
1888.	Males	588	280	75	144	213	177	180	257	392	507	377	47	1	53
	Females	459	243	65	194	271	241	199	262	375	511	360	79	5	21
	Not stated	13													1
	Total	1,060	523	140	338	484	418	379	519	767	1,018	737	126	6	87
1889.	Males	536	269	90	131	187	186	175	241	381	492	342	43		29
	Females	470	245	88	179	251	226	222	270	398	471	366	75	3	29
	Not stated	8	2		1	1									1
	Total	1,014	516	178	311	439	412	397	511	779	963	708	118	3	59
1890.	Males	609	250	73	143	229	242	220	308	422	576	368	52		59
	Females	524	216	66	156	263	277	242	332	399	513	406	86	5	44
	Not stated	13	2								1				10
	Total	1,146	468	139	299	492	519	462	640	821	1,090	774	138	5	113
1891.	Males	703	256	86	134	248	206	210	279	438	530	346	52		69
	Females	551	231	90	170	232	208	225	284	395	507	412	97	3	48
	Not stated	10	2				1								1
	Total	1,264	489	176	304	480	415	435	563	833	1,037	758	149	3	118

*** Excluding still births and premature births.**

Table No. 7 shows the number of deaths at different age periods by sex, from 1884 to 1891, inclusive. In the year 1891 there were returned 1,226 deaths of children under one year of age, not including still births and premature births; 489 between one and five; 176 between five and ten; 304 between ten and twenty; 480 between twenty and thirty; 415 between thirty and forty; 435 between forty and fifty; 563 between fifty and sixty; 833 between sixty and seventy; 1,037 between seventy and eighty; 758 between eighty and ninety; 149 between ninety and one hundred; 3 over one hundred; and 118 with age not stated.

Compared with previous years it will be seen that there has been almost an alarming increase of deaths in children under one year of age, which is largely accounted for by an increase of deaths from diarrhœal diseases, chiefly cholera infantum. The variation in some of the other age periods though considerable is not so marked as in the instance referred to.

Table No. 8 shows the percentages of deaths, by age periods and sex, to the total mortality from 1884 to 1891, inclusive. Tables 7 and 8 are interesting and instructive inasmuch as they give the number of deaths and the percentage to the total mortality by age periods, for the seven years embraced in the tables. There are no other tables that so emphatically exhibit the large mortality that annually occurs among children under one year of age. It will be seen that nearly one fourth of all the deaths in the State for the year 1891 were of children under five years of age. This excessive mortality among the young offers a subject for reflection and study for those who are interested or engaged in efforts to reduce the mortality rate of the State. It is admitted by those who have given the subject any attention that so large a death-rate among children is preventable, and that the means are at the command of the individual and the public to reduce these figures very materially. This view is emphatically corroborated by a detailed exhibit of the causes of death among children.

TABLE No. 8.

Percentages of Deaths by Ages and Sex to Total Mortality, from 1884 *to* 1891, *inclusive.**

YEARS.	Under 1.	1 to 5.	5 to 10.	10 to 20.	20 to 30.	30 to 40.	40 to 50.	50 to 60.	60 to 70.	70 to 80.	80 to 90.	90 to 100.	Over 100.
1884..Males	16.00	8.45	2.51	4.73	7.79	5.84	6.26	8.52	11.20	17.46	10.16	1.04	.04
Females	11.74	7.05	2.99	6.38	8.84	7.31	7.02	7.81	11.17	14.76	12.60	2.33	...
Total	13.82	7.73	2.75	5.57	8.33	6.60	6.65	8.16	11.18	16.08	11.41	1.70	.02
1885..Males	14.78	8.00	2.20	3.87	6.75	6.43	6.75	8.96	14.00	16.99	10.09	1.14	.04
Females	12.07	7.06	2.21	5.34	8.95	7.65	7.35	7.32	11.55	15.07	12.95	2.41	.07
Total	13.37	7.51	2.21	4.64	7.95	7.07	7.07	8.10	12.72	15.98	11.58	1.80	.05
1886..Males	16.06	9.00	3.10	4.35	6.75	6.20	6.53	7.52	12.13	16.45	10.45	1.39	.07
Females	12.36	7.10	2.89	5.71	9.37	7.48	6.26	8.09	10.88	14.35	12.74	2.67	.10
Total	14.18	8.04	2.99	5.04	8.08	6.85	6.39	7.81	11.50	15.39	11.62	2.03	.08
1887..Males	16.20	7.64	2.35	4.69	6.48	6.08	6.15	8.40	12.46	16.92	11.11	1.49	.03
Females	13.19	7.58	1.94	5.55	8.09	7.01	7.58	7.80	11.35	15.67	11.10	2.95	.19
Total	14.67	7.61	2.14	5.13	7.30	6.56	6.88	8.09	11.90	16.28	11.10	2.23	.11
1888..Males	18.16	8.65	2.31	4.45	6.58	5.47	5.56	7.94	12.10	15.66	11.64	1.45	.03
Females	14.06	7.45	1.99	5.94	8.30	7.38	6.10	8.03	11.49	15.66	11.03	2.42	.15
Total	16.10	8.04	2.15	5.20	7.44	6.43	5.83	7.98	11.80	15.66	11.34	1.94	.09

1889..Males	17.44	8.75	2.93	4.26	6.09	6.05	5.70	7.84	12.40	16.01	11.13	1.40	...
Females	14.40	7.51	2.70	5.48	7.69	6.92	6.80	8.27	12.20	14.43	11.21	2.30	.09
Total	15.88	8.11	2.81	4.89	6.91	6.50	6.27	8.06	12.29	15.20	11.17	1.86	.05
1890..Males	17.44	7.15	2.09	4.09	6.55	6.93	6.30	8.82	12.08	16.49	10.54	1.49	...
Females	15.03	6.19	1.89	4.47	7.54	7.94	6.94	9.52	11.45	14.72	11.65	2.46	.14
Total	16.23	6.67	1.99	4.28	7.04	7.43	6.62	9.17	11.76	15.60	11.09	1.97	.07
1891..Males	20.15	7.34	2.47	3.84	7.11	5.91	6.02	8.00	12.56	15.15	9.92	1.49	...
Females	16.18	6.78	2.61	4.99	6.81	6.11	6.61	8.34	11.60	14.88	12.09	2.85	.08
Total	18.19	7.06	2.55	4.41	6.96	6.01	6.31	8.16	12.08	15.04	10.99	2.16	.04

* Excluding those with age and sex not stated, and premature and still births.

TABLE No. 9.

Deaths of Children under Five Years of Age, by Seasons, 1891. *

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Months	102	103	104	107	94	113	205	298	224	160	89	143
Quarters		309			314			727			392	
Percentages		17.73			18.02			41.72			22.51	
Half-years			623						1,119			
Percentages			35.76						64.24			
Total deaths							1,742					

* Not including deaths with month not stated.

This table represents the mortality of children under five years of age, by seasons, for the year 1891. The greatest mortality of the year occurred in the quarter embracing the months of July, August, and September, and was 41.72 per cent of the total mortality among children, as against 17.73 per cent for the first quarter, 18.02 per cent for the second, and 22.51 per cent for the last quarter of the year. There were 1,742 deaths among children under five years of age during the year, or 128 more than were recorded in 1890.

For the latter year the percentages were as follows: First quarter, 19.95; second quarter, 15.92; third quarter, 44.23; last quarter, 19.88.

TABLE No. 10.

Total Deaths by Seasons, 1891.*

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Months.....	533	466	565	538	604	547	579	680	622	563	496	800
Quarters		1,564			1,689			1,881			1,859	
Percentages		22.37			24.15			26.89			26.58	
Half-years			3,253						3,740			
Percentages....			46.52						53.48			
Total deaths.							6,993					

* Not including deaths with month not stated, premature and still births.

This table gives the total number of deaths at all ages, by seasons, for the year 1891. There was a total of 6,993 deaths, not including those with month not stated, premature and still births. The greatest mortality was in the month of December, 800, and the least in February, 466.

The percentages, by quarters, were as follows: First quarter, 22.37; second quarter, 24.15; third quarter, 26.89; last quarter, 26.58.

The percentage for the first half of the year was 46.52; for the last half, 53.48.

TABLE No. 11.

Nativity of Persons Deceased for 1891, *by Counties.*

COUNTIES.	Total deaths.*	NATIVE-BORN.		FOREIGN-BORN.	
		Deaths.	Percentages.	Deaths.	Percentages.
Rockingham	991	784	89.49	92	10.50
Strafford	809	644	85.08	113	14.92
Belknap	392	286	92.25	24	7.74
Carroll	341	293	96.69	10	3.30
Merrimack	951	788	89.24	95	10.75
Hillsborough	1,957	1,373	78.63	373	21.36
Cheshire	482	390	89.24	47	10.75
Sullivan	280	229	92.71	18	7.28
Grafton	648	539	93.90	35	6.09
Coös	459	311	81.41	71	18.58
Total	7,310	5,637	86.52	878	13.47

* Including those whose nativity was not recorded. In the calculations of percentages, the rates are not given to the *total* reported deaths, but only to the total of those cases where the nativity was stated.

This table gives the nativity of the decedents for the year 1891, together with the percentages of each, by counties. The greatest number of foreign-born decedents, as well as the highest rate, was in Hillsborough county, where there is a larger foreign-born population, being 373 or 21.36 per cent; Coös follows with 18.58; Strafford, 14.92; Merrimack and Cheshire, 10.75 each; Rockingham, 10.50; Belknap, 7.74; Sullivan, 7.28; Grafton, 6.09; Carroll, 3.30. The total foreign-born decedents for the State were 878, a rate of 13.47. The rate for the preceding year was 13.55.

TABLE No. 12.

Nativity of Persons Deceased from 1884 *to* 1891, *inclusive.*

YEARS.	Total deaths.*	NATIVE-BORN.		FOREIGN-BORN.	
		Deaths.	Percentages.	Deaths.	Percentages.
1884	6,194	4,868	89.01	601	10.99
1885	6,201	4,847	89.35	578	10.65
1886	6,426	4,989	88.52	647	11.48
1887	6,479	5,131	88.03	698	11.97
1888	6,854	5,449	87.53	776	12.47
1889	6,696	5,383	88.00	734	12.00
1890	7,368	5,672	86.45	889	13.55
1891	7,310	5,637	86.52	878	13.47

* Including those whose nativity was not recorded. In the calculations of percentages, the ratios are not given to the *total* reported deaths, but only to the total of those cases where the nativity was stated.

Table No. 12 shows the number of native and foreign-born decedents in the State for each year from 1884 to 1891, inclusive, with percentages of each.

Of a total of 7,310 deaths in the State returned for the year 1891, 5,637, or 86.52 per cent, were native-born, and 878, or 13.47 per cent, foreign-born.

TABLE No. 13.

Deaths in 1891 *of Persons Aged One Hundred Years, or more.*

Date of death.	NAME.	AGE.			Place of death.	Birthplace.	Single, married, or widowed.
		Years.	Months.	Days.			
July 22	Ellen Scott	104	....	....	Portsmouth	Ireland	Widow.
June 26	Betsey Graves Wam	101	....	2	Walpole	Walpole	Widow.
September 11	Elizabeth Kidder	102	1	14	Stewartstown	New Hampshire.	Widow.

CAUSES OF DEATH.

There were returned for the year 1891, 7,310 deaths, of which 3,717 were males, 3,544 females, and 49 with sex not stated. In 353 cases the cause of death was not specified.

TABLE No. 14.

Causes of Death, by Classes, from 1884 *to* 1891, *inclusive.*

	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.
I. — Zymotic diseases ...	907	890	1,095	1,073	1,097	1,172	1,155	1,301
II. — Constitutional diseases	1,276	1,271	1,284	1,222	1,200	1,114	1,309	1,095
III. — Local diseases	2,594	2,637	2,610	2,731	2,994	2,852	3,146	3,149
IV. — Developmental diseases	857	848	948	952	1,016	1,041	1,150	1,141
V. — Violent deaths.....	201	225	206	218	234	233	271	271

This table gives the causes of deaths, by classes, for the years 1884 to 1891, inclusive.

There were attributed to the zymotic diseases 1,301 deaths; constitutional diseases, 1,095; local diseases, 3,149; developmental diseases, 1,141; and to violent deaths, 271. There was a marked increase of deaths in the zymotic class over the number reported in 1890. Under constitutional diseases there were returned 204 less than for the preceding year. Under the other classes the variation was small. In class five, violent deaths, there is remarkable uniformity from year to year.

TABLE No. 15.

Percentage of Causes of Death, by Classes, from 1884 *to* 1891, *inclusive.**

YEARS.	CLASSES.				
	Zymotic.	Constitutional.	Local.	Developmental.	Violent deaths.
1884	15.9	22.4	45.7	12.3	3.5
1885	13.9	22.2	46.0	12.2	3.6
1886	18.2	21.4	43.4	13.4	3.4
1887	17.9	20.4	45.7	12.1	3.6
1888	17.4	19.1	47.6	12.0	3.7
1889	19.1	18.2	46.5	12.3	3.8
1890	17.0	19.3	46.5	13.1	4.0
1891	19.5	16.4	47.2	12.8	4.0

* Excluding deaths from unspecified causes, premature and still births.

Table No. 15 gives the percentages of causes of death, by classes, excluding deaths from unspecified causes, premature and still births, from the year 1884 to 1890, inclusive. This table presents substantially the same information as table No. 14, but in the form of percentages. The relative fatality of each class of diseases is vividly shown. The increase of the percentage of deaths from zymotic diseases during the period included in the table as well as the decrease of constitutional diseases, is especially noticeable.

TABLE No. 16.

Causes of Death, by Classes and Counties, 1891.

COUNTIES.	Zymotic.		Constitutional.		Local.		Developmental.		Violent.		Unspecified.		Total.
	Number.	Percentages.	Number.	Percentages.	Number.	Percentages.	Number.	Percentages.	Number.	Percentages.	Number.	Percentages.	
Rockingham	165	16.65	136	13.72	446	45.01	152	15.34	36	3.63	56	5.65	991
Strafford	155	19.16	133	16.44	310	38.31	137	16.93	36	4.45	38	4.70	809
Belknap	90	22.96	64	16.33	166	42.35	58	14.79	6	1.53	8	2.04	392
Carroll	36	10.55	49	14.37	173	50.73	55	16.13	16	4.69	12	3.52	341
Merrimack	145	15.25	155	16.30	436	45.85	161	16.93	34	3.57	20	2.10	951
Hillsborough	377	19.26	298	15.23	766	39.14	309	15.79	49	2.50	158	8.07	1,957
Cheshire	68	14.11	82	17.01	223	46.27	66	13.69	26	5.39	17	3.53	482
Sullivan	34	12.14	41	14.64	146	52.14	47	16.79	9	3.21	3	1.07	280
Grafton	108	16.66	96	14.81	300	46.29	100	15.43	30	4.63	14	2.16	648
Coös	123	26.79	41	8.93	183	39.87	56	12.20	29	6.32	27	5.88	459
Total	1,301	17.79	1,095	14.98	3,149	43.08	1,141	15.61	271	3.71	353	4.83	7,310

Table No. 16 gives the causes of death, by classes and counties, for 1891, with the percentages of each to the total number of deaths, and including deaths from unspecified causes, premature and still births, which accounts for the differences in the percentages in tables 15 and 16; the former gives the percentage of each class to the total number of specified causes, excluding premature and still births, while the latter gives the percentage of each class to the total number of all classes. The highest percentage in the zymotic class is in Coös county, 26.79; Belknap, 22.96; Hillsborough, 19.26; Strafford, 19.16; Grafton, 16.66; Rockingham, 16.65; Merrimack, 15.25; Cheshire, 14.11; Sullivan, 12.14; and the lowest in Carroll county, 10.55. The percentage of deaths in this class for the entire State was 17.79 to the total mortality, as against 15.67 for 1890.

The percentages in the class of constitutional diseases do not vary so much in the different counties, the highest rate being 17.01 in Cheshire county, followed by 16.44 in Strafford, 16.33 in Belknap, 16.30 in Merrimack, 15.33 in Hillsborough, 14.81 in Grafton, 14.64 in Sullivan, 14.37 in Carroll, 13.72 in Rockingham, and the lowest, 8.93, in Coös. The percentage of this class for the whole State was 17.76 in 1890, and 16.63 the previous year.

In the class of local diseases the highest rate was in Sullivan, 52.14; Carroll, 50.73; Grafton, 46.29; Cheshire, 46.27; Merrimack, 45.83; Rockingham, 45.01; Belknap, 42.35; Coös, 39.87; Hillsborough, 39.14; Strafford, 38.31. The rate for the State in this class was 43.08.

In the developmental class the rate for the State was 15.61. The variations in the percentages by counties are much less than in the other classes, the highest being 16.93, in Strafford and Merrimack counties, and the lowest, 12.30, in Coös.

There were 271 deaths from violent causes, and 353 from unspecified causes.

TABLE No. 17.

Mortality from Prominent Zymotic Diseases, from 1884 *to* 1891, *inclusive.*

YEARS.	DISEASES.												
	Cholera infantum.	Croup.	Diarrhea.	Diphtheria.	Dysentery.	Erysipelas.	Fever, cerebro-spinal.	Fever, typhoid.*	Measles.	Pertussis.	Scarlatina.	Septicæmia.	Total.
1884	266	49	53	110	80	19	25	137	3	14	52	27	835
1885	219	74	59	78	40	25	20	136	45	25	53	38	812
1886	362	64	38	156	79	18	26	194	18	26	21	27	1,029
1887	336	84	38	177	53	20	34	134	39	21	26	30	992
1888	370	94	50	103	63	36	34	150	55	23	34	29	1,041
1889	353	88	68	210	67	27	25	161	16	47	18	29	1,109
1890	399	64	50	164	48	29	...	143	9	26	16	57	1,005
1891	486	56	46	160	51	43	...	170	19	27	13	38	1,109
Average	349	72	50	145	60	27	21	153	26	26	29	34	992

* Including fever, bilious, intermittent, malarial, and typho-malarial fevers.

Table No. 17 exhibits the mortality from prominent zymotic diseases. Cholera infantum was the cause of more than one third of all the deaths of this class, 486 in a total of 1,109, and 87 more than were returned in 1890. The increase of the number of deaths from this disease during the period embraced in the table is especially noticeable.

Typhoid fever shows an increase in number of decedents over those returned for the preceding four years. Croup, diphtheria, diarrhea, scarlet fever, and septicæmia show a falling off from the numbers reported for 1890; dysentery, measles, and whooping cough a slight increase.

The average mortality from the zymotic diseases for the past eight years is 992 as against 1,109 for 1891.

TABLE No. 18.

Mortality from Principal Constitutional Diseases, from 1884 *to* 1891, *inclusive.*

YEARS.	DISEASES.										
	Dropsy.	Anæmia.	Cancer.	Mortification.	Rheumatism.	Scrofula.	Tabes mesenterica.	Phthisis (pulmonary).	Hydrocephalus.	Tubercular meningitis.	Total.
1884	80	43	213	18	26	26	4	865	27	*	1,302
1885	90	32	212	24	28	22	2	857	25	*	1,292
1886	83	28	206	27	47	16	11	809	33	19	1,279
1887	79	17	218	29	47	16	7	766	23	16	1,218
1888	75	34	203	22	43	21	14	742	30	13	1,197
1889	62	40	213	21	43	22	13	651	21	24	1,110
1890	53	28	276	33	30	15	6	825	13	30	1,309
1891	41	41	213	2	24	11	19	695	22	15	1,083
Average.	70	33	219	22	36	19	9	776	24	15	1,224

* Not classed separately.

The mortality from the chief constitutional diseases from 1884 to 1891, inclusive, is shown in table No. 18. Phthisis, as always, stands at the head, numerically, as the cause of death. There were recorded in 1891, 695 deaths from this disease, 130 less than were returned the preceding year. A close study of this and other tables indicates that the mortality from phthisis is being somewhat reduced in New Hampshire.

There was a falling off of 63 deaths from cancer from the number returned in 1890, the mortality for 1891 being 213. The annual uniformity of the number of decedents from this disease is striking.

TABLE No. 19.

Mortality from Principal Local Diseases from 1884 *to* 1891, *inclusive.*

YEARS.	DISEASES.													
	Apoplexy.	Paralysis.	Convulsions.	Cephalitis.*	Brain disease.	Heart disease.	Bronchitis.	Pneumonia.	Enteritis.	Gastritis.	Peritonitis.	Liver disease.	Bright's disease, nephritis, and other kidney diseases.	Total.
1884	192	248	99	120	134	507	78	436	69	44	61	63	140	2,191
1885	206	278	93	133	122	489	112	504	57	49	44	63	157	2,307
1886	220	249	71	141	127	510	81	466	53	66	48	71	143	2,246
1887	210	253	64	117	121	552	114	556	57	54	48	69	163	2,384
1888	243	273	88	143	112	575	142	628	39	51	63	72	154	2,634
1889	259	196	76	151	126	564	127	582	56	42	57	56	200	2,492
1890	263	251	65	186	140	568	194	703	63	60	51	56	201	2,801
1891	283	241	78	161	130	572	180	673	73	47	68	55	182	2,743
Average	234	249	79	144	126	542	128	568	58	52	55	63	167	2,475

* Meningitis and cerebritis included.

Table No. 19 gives the mortality from the principal local diseases from 1884 to 1891, inclusive. The annual average for the eight years is 2,475, the total for 1891 being 2,734.

Pneumonia is the predominating disease in this class. The number of deaths returned from this cause in 1891 was 673, 30 less than was reported for the preceding year.

Next in order of fatality comes heart disease with 572 deaths for the year 1891; then follows apoplexy with 283 deaths; paralysis, 241; Bright's disease, 182; bronchitis, 180; cephalitis, 161; brain disease, 130; convulsions, 78; enteritis, 73; peritonitis, 68; liver disease, 55; and gastritis, 47.

TABLE No. 20.

Mortality from Principal Developmental Diseases from 1884 *to* 1891, *inclusive.*

YEARS.	DISEASES.									
	Still-born.	Debility, infantile.	Debility, premature birth.	Malformation.	Teething.	Innutrition.	Childbirth.	Old age.	Atrophy and debility.	Total.
1884	156	*	35	13	19	*	27	457	144	851
1885	145	*	39	13	13	*	31	420	167	828
1886	140	68	54	12	16	50	30	468	98	936
1887	166	56	63	10	20	76	27	449	78	945
1888	189	91	69	19	20	81	20	407	112	1,008
1889	220	79	68	24	18	63	27	426	104	1,029
1890	197	113	65	11	15	95	28	410	204	1,138
1891	213	104	73	18	14	90	23	385	208	1,128
Average	178	65	58	15	17	57	27	428	139	983

* Classed with atrophy and debility.

Table No. 20 shows the mortality from the principal developmental diseases for the eight years given.

The variations in this class from year to year are not especially marked.

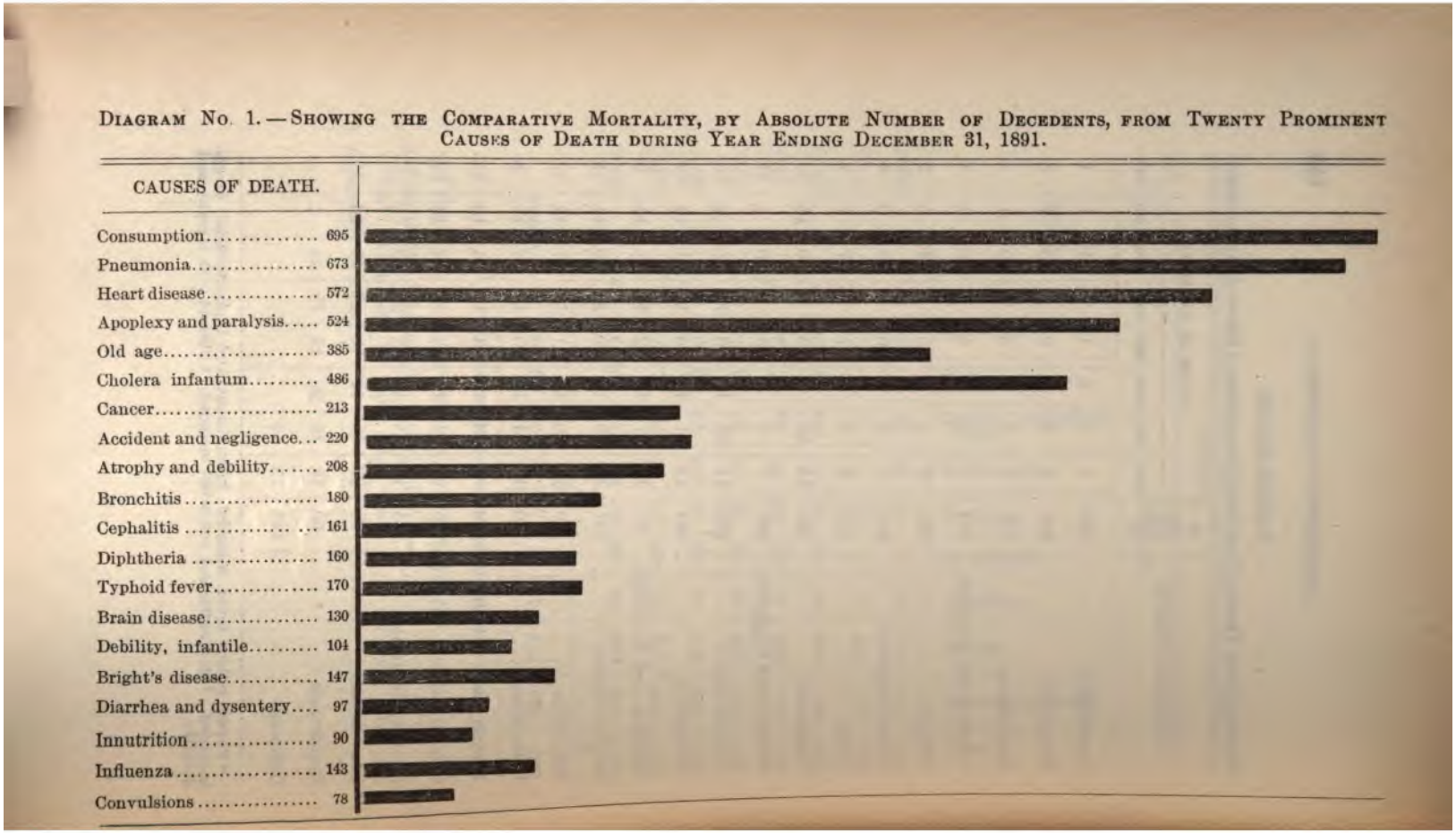
TABLE No. 21.

Mortality from Twenty Prominent Causes from 1884 *to* 1891, *inclusive.*

CAUSES OF DEATH.	Deaths in 1891.	ORDER OF FATALITY.							
		1891.	1890.	1889.	1888.	1887.	1886.	1885.	1884.
Consumption	695	1	1	1	1	1	1	1	1
Pneumonia	673	2	2	2	2	3	5	2	5
Heart disease	572	3	3	3	3	2	2	4	2
Apoplexy and paralysis	524	4	4	4	4	4	3	3	4
Old age	385	6	5	5	5	5	4	5	3
Cholera infantum	486	5	6	6	6	6	6	6	6
Cancer	213	8	7	7	7	7	7	7	7
Diphtheria	160	13	12	8	15	9	10	18	13
Accident and negligence	220	7	8	9	8	8	9	8	11
Typhoid fever *	170	11	13	10	9	10	8	9	10
Cephalitis †	161	12	11	11	10	12	11	10	12
Diarrhea and dysentery	97	18	17	12	12	14	13	15	9
Bright's disease	147	14	16	13	20	15	15	14	14
Bronchitis	180	10	10	14	11	13	17	12	17
Brain disease	130	16	14	15	13	11	12	11	8
Atrophy and debility	208	9	9	16	14	18	14	13	18
Croup	56	21	21	17	16	16	21	19	22
Debility, infantile	104	17	15	18	17	23	22	‡	....
Convulsions	78	20	20	19	18	21	19	16	15
Innutrition	90	19	18	20	19	19	23	‡	....
Influenza	143	15	19	....	....	....	....	....	....

* Fever, bilious fever, malarial, intermittent, and typho-malarial fevers included. † Meningitis and cerebritis included. ‡ Classed with atrophy and debility.

DIAGRAM NO. 1. — SHOWING THE COMPARATIVE MORTALITY, BY ABSOLUTE NUMBER OF DECEDENTS, FROM TWENTY PROMINENT CAUSES OF DEATH DURING YEAR ENDING DECEMBER 31, 1891.



CONSUMPTION.

Table No. 21 gives a comparative view of the mortality from twenty prominent causes of death from 1884 to 1890, inclusive. This table together with the diagram that follows, is interesting in studying the relative positions of the more prominent causes of death, from year to year. Consumption, as it always has done, heads the list, and is responsible for more deaths than any other disease. The long black line at the head of the diagram is of appalling significance. There were returned in 1891, 695 deaths from this disease. Next in order comes pneumonia. This disease has stood second among the causes of mortality in this State for the past four years. In 1887, it was third, and in 1886 and 1884 it was fifth in the order of fatality. Heart disease ranks third in 1891, with a mortality of 572; apoplexy and paralysis fourth, with 524; cholera infantum went from the sixth position, which it has hitherto held, up to the fifth, with a mortality of 486; old age is sixth, with 385, a lower position than has been heretofore recorded. Cancer decreased from the seventh position to the eighth, with a total of 213 deaths. Diphtheria shows a mortality of 160 for 1891, and is thirteenth on the list. Accident and negligence is seventh, with 220 deaths. Typhoid fever is eleventh, with 170 deaths; cephalitis twelfth, with 162; Bright's disease fourteenth, with 147; atrophy and debility ninth, with 208; croup twenty-first, with 56; infantile debility seventeenth, with 104; convulsions twentieth, with 78; innutrition nineteenth, with 90; and influenza fifteenth, with 143. The relative positions of these diseases for the past eight years may be seen by studying table No. 21.

TABLE No. 22.

Mortality from Consumption, from 1884 *to* 1891, *inclusive.*

YEARS.	Deaths.	Percentages of deaths to deaths from all causes.	Death-rate per 10,000 living population.
1884	865	14.01	24.18
1885	857	13.82	23.68
1886	809	12.58	22.17
1887	766	11.82	20.82
1888	742	10.82	20.01
1889	651	9.72	17.42
1890	825	11.19	21.91
1891	695	9.51	18.31
Totals	6,210	.....	.....

The mortality from consumption, the percentage of the same to the total mortality, and the rate per 10,000 of the population, is shown in the above table, for the years 1884 to 1891, inclusive. It will be seen that there was a considerable diminution in the mortality from this disease between the years 1884 and 1889, but was largely increased in 1890, but in 1891 it again fell to nearly the lowest figures recorded during the past eight years. In commenting upon the returns of 1890 we said: We have entertained the belief that an increased knowledge of the nature of consumption and the measures necessary to restrict and prevent it may have had some influence in causing this reduction. The increased mortality in 1890 does not weaken our opinion, and is to be accounted for, to a large extent if not wholly, by the climatic or other causes to which has been due epidemic influenza or

la grippe. That this condition has been a very marked and important factor in causing the increased mortality from certain diseases, has already been shown; therefore we are disposed to attribute the large increase in the deaths from consumption in 1890, to the climatic conditions of this particular period. The great force of the epidemic of influenza which extended into 1891, seems to have been particularly fatal to consumptives in the preceding year, doubtless owing to the fact that a large number of persons well advanced in phthisis succumbed to the two diseases, leaving a far less number of consumptives unable to resist the conditions of 1891.

Table No. 23 shows the mortality from consumption, by counties, with percentages to total mortality, from 1884 to 1890, inclusive. Strafford county has the highest rate for 1891, 11.62; Belknap, 11.23; Cheshire, 10.16; Hillsborough, 10.06; Carroll, 9.38; Merrimack, 9.36; Grafton, 8.79; Rockingham, 8.57; Sullivan, 7.15; Coös, 6.10. The average for the State to the total mortality for 1891 was 9.51.

TABLE No. 23.

Mortality from Consumption, by Counties, with Percentages of Deaths to Total Mortality, from 1884 *to* 1891, *inclusive.*

COUNTIES.	1884.		1885.		1886.		1887.		1888.		1889.		1890.		1891.	
	Deaths.	Percentages.	Deaths.	Percentages.	Deaths.	Percentages.	Deaths.	Percentages.	Deaths.	Percentages.	Deaths.	Percentages.	Deaths.	Percentages.	Deaths.	Percentages.
Rockingham.....	130	14.89	134	14.70	142	14.74	130	14.84	96	10.71	88	10.05	134	12.58	85	8.57
Strafford.....	105	16.74	96	15.50	96	15.76	80	11.88	93	13.51	75	10.85	117	14.60	94	11.62
Belknap.....	54	18.94	50	17.30	37	10.22	48	13.06	46	11.73	42	10.79	40	10.69	44	11.23
Carroll.....	46	13.81	33	12.26	41	13.53	33	11.22	26	7.92	29	9.73	25	8.25	32	9.38
Merrimack	91	12.36	102	12.81	79	9.48	96	11.49	101	10.97	88	9.87	114	11.59	89	9.36
Hillsborough	229	13.83	233	13.69	218	12.96	179	10.55	209	11.32	168	9.64	204	10.33	197	10.06
Cheshire.....	62	12.47	75	15.18	60	12.63	50	10.37	47	9.63	53	10.09	51	9.15	49	10.16
Sullivan.....	36	13.18	36	12.67	45	13.72	32	11.30	36	11.00	28	8.91	32	9.63	20	7.15
Grafton	83	12.73	70	11.45	72	11.72	80	13.28	63	9.61	58	9.27	70	10.75	57	8.79
Coös.....	32	12.16	28	12.33	19	7.42	38	10.32	25	7.96	22	6.32	38	11.51	28	6.10
Total	868	14.01	857	13.82	809	12.58	766	11.82	742	10.82	651	9.72	825	11.19	695	9.51

The mortality from consumption in the cities of the State is shown in the following tables.

TABLE No. 24.

Deaths from Pulmonary Consumption, by Seasons, Ages, and Nativity, 1891, for the City of Manchester.

Months	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.	American.	Foreign.	Not stated.
	11	9	4	11	8	9	7	6	10	5	9	9				
Quarters	24			28			23			23			98			
Ages	Under 10.	10 to 15.	15 to 20.	20 to 30.	30 to 40.	40 to 50.	50 to 60.	60 to 70.	70 to 80.	Over 80.	Not stated.					
	9	4	11	28	16	19	6	2	3							
Nativity														46	44	8
Males													44			
Females													54			

Percentage to total mortality of city, 10.40.

Table No. 24 gives the deaths from consumption by months, seasons, ages, and nativity in the city of Manchester for 1891. Total number of deaths from this cause for the year was 98 as against 106 in 1890. Of these 44 were males and 54 females; 46 were American-born, 44 foreign-born, and 8 nativity not stated. The greatest fatality was in April and January, 11 each of those months; September, 10; February, June, November, and December, 9 each; May, 8; July, 7; August, 6; October, 5; March, 4.

Nine of the decedents were under 10 years of age; 4 between 10 and 15; 11 between 15 and 20; 28 between 20 and 30; 16 between 30 and 40; 19 between 40 and 50; 6 between 50 and 60; 2 between 60 and 70; and 2 over 70. The rate to the total mortality of the city was 10.40 per cent.

TABLE No. 25.

Deaths from Pulmonary Consumption, by Seasons, Ages, and Nativity, 1891, for the City of Concord.

| | | |

TABLE No. 26.

Deaths from Pulmonary Consumption, by Seasons, Ages, and Nativity, 1891, for the City of Nashua.

| | | |

TABLE No. 27.

Deaths from Pulmonary Consumption, by Seasons, Ages, and Nativity, 1891, for the City of Portsmouth.

Months	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.	American.	Foreign.	Not stated.
	1	2	1	3		1	3	4		1	1					
Quarters	4			4			7			2			17			
Ages	Under 10.	10 to 15.	15 to 20.	20 to 30.	30 to 40.	40 to 50.	50 to 60.	60 to 70.	70 to 80.	Over 80.	Not stated.					
			1	6	5	1	2	1	1							
Nativity														14	1	2
Males													13			
Females													4			

Percentage to total mortality of city, 8.17.

The mortality from consumption in the city of Portsmouth for the year 1891 was 17, as against 37 reported the previous year — 13 males and 4 females. In August there were 4 deaths; in April and July, 3 each; in February, 2; in January, March, June, October, and November, 1 each. One of the decedents was between 15 and 20 years of age; 6 between 20 and 30; 5 between 30 and 40; 1 between 40 and 50; 2 between 50 and 60; 1 between 60 and 70; and 1 over 70. Fourteen were American-born, 1 foreign-born, and 1 nativity not stated.

TABLE No. 28.

Deaths from Pulmonary Consumption, by Seasons, Ages, and Nativity, 1891, for the City of Dover.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.	American.	Foreign.	Not stated.
Months	6	2	2	2	4	4	2	2	4	1	4	4				
Quarters	10			10			8			9			37			
Ages	Under 10.	10 to 15.	15 to 20.	20 to 30.	30 to 40.	40 to 50.	50 to 60.	60 to 70.	70 to 80.	Over 80.	Not stated.					
	3		6	10	6	6	2	1	3							
Nativity														26	10	1
Males													17			
Females													20			

Percentage to total mortality of city, 12.01.

The number of deaths returned from the city of Dover for 1891 was 37, as against 52 in 1890 — 17 males and 20 females. Six died in January; 4 each in May, June, September, November, and December; 2 each in February, March, April, July, and August; and 1 in October. Three of the decedents were under 10 years of age; 6 between 15 and 20; 10 between 20 and 30; 6 between 30 and 40; 6 between 40 and 50; 2 between 50 and 60; 1 between 60 and 70; 3 between 70 and 80. Twenty-six were American-born, 10 foreign-born, and 1 nativity not stated.

TABLE No. 29.

Deaths from Pulmonary Consumption, by Seasons, Ages, and Nativity, 1891, for the City of Keene.

Months	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.	American.	Foreign.
	1		1	2	2	1	1			3	1	3			
Quarters		2			5			1			7		15		
Ages	Under 10.	10 to 15.	15 to 20.	20 to 30.	30 to 40.	40 to 50.	50 to 60.	60 to 70.	70 to 80.	Over 80.	Not stated.				
	1		2	3	3	1	4			1					
Nativity														12	3
Males													5		
Females													10		

Percentage to total mortality of city, 11.90.

The city of Keene returned 15 deaths from consumption in 1891 — 5 males and 10 females. Three each died in October and December; 2 each in April and May; 1 each in January, March, June, July, and November. One decedent was under 10 years of age; 2 between 15 and 20; 3 between 20 and 30; 3 between 30 and 40; 1 between 40 and 50; 4 between 50 and 60; 1 over eighty. Twelve were American-born and 3 foreign-born.

TABLE No. 30.

Deaths from Pulmonary Consumption, by Seasons, Ages, and Nativity, 1891, for the City of Rochester.

Months	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.	American.	Foreign.	Not stated.
	3	4	2	1	2	1	1			2		1				
Quarters	9			4			1			3			17			
Ages	Under 10.	10 to 15.	15 to 20.	20 to 30.	30 to 40.	40 to 50.	50 to 60.	60 to 70.	70 to 80.	Over 80.	Not stated.					
	1		4	4	4		1		1		2					
Nativity													16			1
Males													6			
Females													11			

Percentage to total mortality of city, 11.80.

Seventeen deaths from consumption were returned from the city of Rochester in 1891—6 males and 11 females. There were 3 deaths in January; 4 in February; 2 each in March, May, and October; 1 each in April, June, July, and December. One decedent was under 10 years of age; 4 between 15 and 20; 4 between 20 and 30; 4 between 30 and 40; 1 between 50 and 60; 1 between 70 and 80; and 2 not stated. Sixteen of the decedents were American-born, and 1 nativity not stated.

TABLE No. 31.

Percentage of Deaths from Consumption to the Total Mortality of the Cities of the State, for the years 1883 *to* 1891, *inclusive.*

	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.
Manchester	14.89	14.28	13.03	15.01	11.15	12.37	9.30	10.29	10.40
Concord...	11.41	8.66	10.68	8.60	10.13	10.23	9.81	9.13	9.30
Nashua....	16.96	13.72	14.86	10.49	9.73	8.20	8.64	10.69	10.29
Dover.....	20.97	16.60	16.17	21.17	14.57	12.01	10.31	16.40	12.01
Portsmouth	16.02	14.74	12.18	17.84	16.26	13.26	7.73	14.34	8.17
Keene.....	16.91	16.00	22.80	16.00	11.90	9.47	9.62	10.25	11.90
Rochester..	.....	.....	.....	.....	.....	.....	.....	.....	11.80

Table No. 31 gives a comparative view of the percentages of deaths from consumption in the several cities of the State for the past eight years, with the exception of Rochester, which has only recently become a city. A decrease of percentages in later years is noticeable.

Table No. 32 gives the mortality of this disease by ages and sex, for the year 1891, by counties.

TABLE No. 32.

Deaths from Consumption, by Ages and Sex, by Counties, for 1891.

COUNTIES.	SEX.	Under 1.	1 to 5.	5 to 10.	10 to 15.	15 to 20.	20 to 30.	30 to 40.	40 to 50.	50 to 60.	60 to 70.	70 to 80.	Over 80.	Not stated.	Total.	Grand total.
Rockingham	Males	1	....	....	....	3	11	8	8	7	3	2	....	....	43	.....
	Females	2	3	1	1	6	11	9	2	2	2	2	1	..	42	85
Strafford	Males	1	1	....	....	6	10	9	5	6	1	1	2	....	42	.....
	Females	1	2	1	1	8	18	9	3	1	2	4	....	2	52	94
Belknap	Males	1	1	1	....	2	5	5	2	2	....	2	....	....	21	.....
	Females	2	....	....	....	3	6	5	2	2	....	2	....	1	23	44
Carroll	Males	....	2	....	....	....	1	1	3	5	1	....	....	....	13	.....
	Females	....	1	....	....	2	4	5	....	2	1	2	2	....	19	32
Merrimack	Males	1	1	1	....	1	12	5	5	2	3	1	....	....	32	.....
	Females	1	1	1	2	10	9	19	4	4	1	5	....	....	57	89
Hillsborough	Males	5	4	....	2	7	22	18	16	7	3	1	....	4	89	.....
	Females	2	1	2	5	9	29	16	21	5	8	7	1	2	108	197
Cheshire	Males	1	....	....	....	1	2	4	2	2	1	2	1	1	17	.....
	Females	....	....	....	....	4	8	3	6	6	3	2	....	....	32	49

TABLE No. 32. — *Continued.*

Deaths from Consumption, by Ages and Sex, by Counties, for 1891.

COUNTIES.	SEX.	Under 1.	1 to 5.	5 to 10.	10 to 15.	15 to 20.	20 to 30.	30 to 40.	40 to 50.	50 to 60.	60 to 70.	70 to 80.	Over 80.	Not stated.	Total.	Grand total.
Sullivan	Males	....	1	....	....	....	3	2	3	1	2	1	....	...	13	.....
	Females	....	....	....	....	....	....	..	....	3	1	2	1	...	7	20
Grafton	Males	....	....	....	2	3	7	6	2	2	1	3	1	...	27	.....
	Females	....	....	2	3	4	6	3	4	2	3	2	1	...	30	57
Coös	Males	1	....	....	1	....	5	2	....	2	1	2	....	...	14	.....
	Females	....	1	....	....	1	5	2	1	4	....	....	....	...	14	28
Total for State		19	19	9	17	70	174	131	89	67	37	43	10	10	695	695

TABLE No. 33.

Deaths from Consumption, by Months and Sex, by Counties, for 1891.

COUNTIES.	SEX.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Not stated.	Total.	Grand total.
Rockingham	Males	4	2	6	8	3	4	3	3	2	3	3	2	....	43	.....
	Females	4	2	5	4	7	1	6	4	3	1	1	4	...	42	85
Strafford	Males	4	4	3	6	4	3	1	3	3	4	4	3	....	42	.....
	Females	10	6	4	4	4	5	4	2	4	2	2	5	....	52	94
Belknap	Males	1	1	1	2	3	3	....	3	4	2	....	1	....	21	.....
	Females	....	2	1	1	2	4	2	4	3	....	2	2	....	23	44
Carroll	Males	....	1	2	3	1	.....	.....	3	1	1	1	.....	.....	13	.....
	Females	2	1	2	1	2	2	1	1	4	3	.....	.....	.....	19	32
Merrimack	Males	5	1	1	3	2	3	5	1	5	2	2	2	...	32	.....
	Females	2	3	3	5	6	9	8	6	2	6	3	4	....	57	89
Hillsborough	Males	9	7	5	7	7	9	7	7	8	3	11	7	2	89	.....
	Females	10	8	4	12	12	8	10	4	12	8	7	13	....	108	197
Cheshire	Males	4	....	1	1	1	....	2	....	3	2	2	1	....	17	.....
	Females	6	1	2	3	5	2	1	....	1	5	3	3	....	32	49

TABLE No. 33. — *Continued.*

Deaths from Consumption, by Months and Sex, by Counties, for 1891.

COUNTIES.	SEX.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Not stated.	Total.	Grand total.
Sullivan	Males	3	1	2	1	1	....	1	1	2	1	....	....	....	13	.....
	Females	....	1	....	1	....	1	2	....	....	1	....	1	....	7	20
Grafton	Males	3	3	4	1	2	2	1	1	3	3	3	1	....	27	.....
	Females	2	3	2	3	4	1	4	4	1	4	....	2	....	30	57
Coös	Males	....	4	2	....	....	2	1	....	1	....	3	1	....	14	.....
	Females	....	3	2	....	1	2	1	1	....	1	1	2	....	14	28
Total for State		69	54	52	66	67	61	60	48	62	52	48	54	2	695	695

TABLE No. 34.

Deaths from Consumption, by Nativity, Civil Condition, and Sex, by Counties, for 1891.

COUNTIES.	SEX.	American.	Foreign.	Not stated.	Married.	Single.	Widowed.	Not stated.	Total.	Grand total.
Rockingham	Males	34	4	5	18	19	*5	1	43	....
	Females	34	4	4	16	22	3	1	42	85
Strafford	Males	33	8	1	21	15	2	4	42	....
	Females	38	10	4	20	26	5	1	52	94
Belknap	Males	15	3	3	9	11	1	....	21	....
	Females	16	2	5	4	12	5	2	23	44
Carroll	Males	12	....	1	8	4	1	....	13	....
	Females	17	1	1	12	6	1	....	19	32
Merrimack	Males	26	5	1	13	17	2	....	32	....
	Females	44	6	7	27	22	*8	....	57	89
Hillsborough	Males	45	33	11	39	38	4	8	89	....
	Females	61	37	10	46	39	6	17	108	197
Cheshire	Males	15	....	2	6	8	2	1	17	....
	Females	27	5	....	18	10	4	....	32	49
Sullivan	Males	11	1	1	11	2	....	....	13	....
	Females	4	1	2	2	....	4	1	7	20
Grafton	Males	20	4	3	11	13	3	....	27	....
	Females	25	4	1	13	13	4	....	30	57
Coös	Males	7	1	6	6	7	....	1	14	....
	Females	9	3	2	9	1	*4	....	14	28
Total for State		493	132	70	309	285	64	37	695	695

* Divorced, 1.

Table No. 34 gives the nativity, civil condition, and sex of the decedents, by counties, for 1891. Out of a total of 695 deaths from this disease 493 were American-born, 132 foreign-born, and 70 nativity not stated; 309 were married, 285 single, 61 widowed, and 3 divorced.

PNEUMONIA.

TABLE No. 35.

Mortality from Pneumonia, by Counties, from 1884 *to* 1891, *inclusive.*

COUNTIES.	YEARS.								Average.
	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	
Rockingham ..	45	63	77	70	83	68	90	77	72
Strafford.....	39	48	37	46	52	38	80	73	52
Belknap	18	24	25	44	50	37	42	28	33
Carroll	30	27	15	33	46	49	37	42	35
Merrimack....	50	72	60	85	73	86	94	73	74
Hillsborough..	110	128	112	128	129	131	158	185	135
Cheshire.....	36	52	39	55	55	52	44	54	48
Sullivan	21	22	23	22	30	31	32	31	26
Grafton.....	66	48	54	52	77	64	74	53	61
Coös.....	21	20	24	21	33	26	52	57	32
Total.....	436	504	466	556	628	582	703	673	568

Table No. 35 gives the mortality from pneumonia, by counties, from 1884 to 1891, inclusive, with averages for that period. The total number of deaths from this disease for the year 1891 was 673, as against 703 for the preceding year.

TABLE No. 36.

Mortality from Pneumonia from 1884 *to* 1891, *inclusive, by Ages.*

YEARS.	Under 1 year.	1 to 5.	5 to 10.	10 to 15.	15 to 20.	20 to 30.	30 to 40.	40 to 50.	50 to 60.	60 to 70.	70 to 80.	Over 80.	Unknown.	Total.
1884.....	51	48	3	3	6	27	23	30	36	50	97	54	8	436
1885.....	69	49	8	4	11	15	27	32	37	72	105	74	1	504
1886.....	57	38	13	6	13	17	24	29	49	68	92	53	7	466
1887.....	68	33	7	5	13	28	32	40	48	89	121	68	4	556
1888.....	67	45	6	10	19	40	49	51	62	67	123	81	8	628
1889.....	61	50	8	12	17	29	36	40	48	98	100	79	4	582
1890.....	73	48	9	10	11	35	46	45	79	106	127	107	7	703
1891.....	73	43	15	6	11	43	31	38	74	109	126	95	9	673

The mortality from pneumonia from 1884 to 1891, inclusive, by age periods is given in table No. 36. It will be seen that for the entire period the mortality is greatest in the age period between 70 and 80. A comparison of these figures with the number of persons living in the different age periods shows pneumonia to be an exceedingly fatal disease to the aged.

TABLE No. 37.

Mortality from Pneumonia, by Months and Quarters, from 1884 *to* 1891, *inclusive.*

YEARS.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Not stated.
1884	55	55	51	52	32	13	14	11	5	28	51	67	2
1885	53	59	101	95	35	25	13	10	10	33	38	32	...
1886	32	44	73	51	51	33	22	18	18	24	46	54	...
1887	71	73	85	85	49	17	13	13	14	34	47	54	1
1888	72	95	75	73	76	24	16	23	21	43	36	72	2
1889	69	66	79	102	51	22	15	19	16	53	41	49	...
1890	213	74	69	43	47	35	18	9	23	23	69	79	1
1891	73	60	82	72	95	41	13	7	14	23	37	152	4
Total	638	526	615	573	436	210	124	110	121	261	365	559	
Quarters	1,779			1,219			355			1,185			

The above table shows the mortality from pneumonia, by months and quarters, from 1884 to 1891, inclusive. For the year 1891 the greatest number of deaths occurred in December, but for the eight years included in the table in January. The smallest number for the year was in August, as well as for the period given.

BRAIN DISEASES.

TABLE No. 38.

Mortality from Brain Diseases from 1884 *to* 1891, *inclusive.*

YEARS.	DISEASES.						
	Cephalitis.*	Apoplexy.	Paralysis.	Insanity.	Convulsions.	Brain diseases.	Total.
1884.....	120	192	248	22	99	134	815
1885.....	133	206	278	27	93	122	859
1886.....	141	220	249	24	71	127	832
1887	117	210	253	25	64	121	790
1888.....	143	243	273	37	88	112	896
1889.....	151	259	196	35	76	126	843
1890.....	186	263	251	28	65	140	933
1891.....	161	283	241	44	78	130	917
Average	144	234	249	30	79	129	861

* Meningitis and Cerebritis included.

Table No. 38 exhibits the mortality from brain diseases for eight years. In 1891 there were returned 917 deaths from brain diseases under the several classifications given in the table. Under apoplexy there were returned 283; paralysis, 241; cephalitis, 161; brain diseases not otherwise classified, 130; convulsions, 78; insanity, 44.

DIARRHEAL DISEASES.

TABLE No. 39.

Mortality from Diarrheal Diseases from 1884 *to* 1891, *inclusive.*

YEARS.	DISEASES.					Total of diarrheal diseases.
	Cholera infantum.	Cholera morbus.	Diarrhea.	Dysentery.	Enteritis.	
1884	266	21	52	80	69	488
1885	219	20	40	40	57	376
1886	362	14	38	79	53	546
1887	336	16	38	53	57	500
1888	370	8	50	63	39	530
1889	353	12	68	67	56	556
1890	399	12	....	50	63	524
1891	486	16	46	51	73	672
Average	349	15	42	60	58	524

There were 672 deaths from diarrheal diseases in 1891, as against 524 in 1890 — 148 more than for the latter year. Cholera infantum was responsible for 486 deaths; enteritis, 73; dysentery, 51; diarrhea, 46; cholera morbus, 16.

CHOLERA INFANTUM.

TABLE No. 40.

Mortality from Cholera Infantum from 1884 *to* 1891, *inclusive.*

YEARS.	Deaths.	Percentage of deaths to deaths from all causes.	Death-rates per 10,000 living (estimated population).
1884	266	4.29	7.41
1885	219	3.53	6.05
1886	362	5.63	9.92
1887	336	5.18	9.13
1888	370	5.39	9.98
1889	353	5.27	9.44
1890	399	5.41	10.59
1891	486	6.64	12.08
Average	349	.....	.....

Table No. 40 exhibits the mortality from cholera infantum, from 1884 to 1891, inclusive; also the percentage of deaths from this disease to deaths from all causes, and the rate to each 10,000 of the living population. The percentages show graphically the increase this disease is making. The number of deaths from it being in 1891, 486, or 137 greater than the average for the past eight years.

TABLE No. 41.

Mortality from Cholera Infantum, by Ages, from 1884 *to* 1891, *inclusive.*

YEARS.	Under 1.	1 to 5.	5 to 10.	10 to 15.	15 to 20.	20 to 30.	30 to 40.	40 to 50.	50 to 60.	60 to 70.	70 to 80.	Over 80.	Unknown.	Total.
1884	214	48	...	...	...	...	1	...	1	...	...	...	2	266
1885	186	33	...	...	...	...	...	...	...	...	...	...	...	219
1886	283	77	2	...	...	...	...	...	...	...	...	...	...	362
1887	284	51	...	...	...	...	...	...	...	...	...	...	1	336
1888	298	70	...	...	...	...	...	...	...	...	...	...	2	370
1889	297	54	1	...	...	...	...	...	...	...	...	...	1	353
1890	343	52	4	...	...	...	...	...	...	...	...	...	...	399
1891	409	74	3	...	..	...	...	...	...	...	...	...	...	486

The above table shows the mortality from cholera infantum, by ages, from 1884 to 1891, inclusive. The largest number reported in any year was 486, in 1891. This table shows most emphatically that this disease is one of early childhood, chiefly confined to the first year of life.

TABLE No. 42.

Cholera Infantum, by Cities.

	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.
Manchester	131	112	88	122	148	117	86	146	122
Dover	7	10	15	15	13	19	5	12	25
Nashua	15	14	13	30	20	39	43	56	55
Portsmouth	4	3	9	6	4	9	9	8	11
Concord	9	12	5	7	8	11	13	8	25
Keene	9	6	2	7	5	2	8	5	5
Rochester	....	....	....	....	....	....	....	....	8
Total for cities	175	157	132	187	198	197	164	235	251
Total for State	278	268	219	362	336	370	353	399	486

This table shows the mortality from cholera infantum in the cities of the State. Of the 486 deaths from this disease in 1891, 235 occurred in the cities. Manchester gives a mortality of 122, which is not only the largest number returned from any city, but much the largest in proportion to the population.

TABLE No. 43.

Mortality from Diphtheria from 1884 *to* 1891, *inclusive, by Ages.*

YEARS.	Under 1.	1 to 5.	5 to 10.	10 to 15.	15 to 20.	20 to 30.	30 to 40.	40 to 50.	50 to 60.	60 to 70.	70 to 80.	Over 80.	Unknown.	Total.
1884	8	39	34	17	4	2	..	1	3	..	..	1	1	110
1885	10	32	22	5	3	4	..	1	1	..	..	..	..	78
1886	9	53	58	22	7	3	1	1	2	..	..	..	..	156
1887	7	74	51	20	6	9	4	2	1	1	1	..	1	177
1888	6	43	36	7	4	2	1	1	2	1	..	..	..	103
1889	7	86	68	18	13	10	3	3	..	1	..	..	1	210
1890	6	64	45	26	10	3	4	3	..	..	..	1	2	164
1891	5	74	48	17	7	2	4	..	..	1	..	..	2	160

Table No. 43 shows the mortality from diphtheria by age periods, from 1884 to 1891, inclusive. One hundred and sixty deaths were reported from this disease for the year 1891, 4 less than were returned the preceding year. The greatest mortality from this cause during the past eight years was in 1889, when 210 deaths were reported. It will be seen by the table that the greatest number of deaths occurred in children between the ages of 1 and 5 years; the next largest number between 5 and 10. This disease is largely confined to childhood. It is not peculiar to any particular season of the year. In 1891, 12 died in January, 15 in February, 13 in March, 11 in April, 17 in May, 12 in June, 5 in July, 12 in August, 10 in September, 14 in October, 13 in November, and 4 in December. Eighty-nine of the decedents were males, 70 females, and 1 sex not stated.

CROUP.

TABLE No. 44.

Mortality from Croup from 1884 *to* 1891, *inclusive, by Ages.*

YEARS.	Under 1.	1 to 5.	5 to 10.	10 to 15.	15 to 20.	20 to 30.	30 to 40.	40 to 50.	50 to 60.	60 to 70.	70 to 80.	Over 80.	Unknown.	Total.
1884	8	35	6	..	..	..	..	..	..	..	..	..	..	49
1885	20	41	9	..	..	1	2	..	1	..	..	..	..	74
1886	13	40	10	1	..	..	..	..	..	..	..	..	..	64
1887	26	48	7	2	..	..	..	..	..	..	1	..	..	84
1888	16	67	9	..	..	..	1	..	..	..	1	..	..	94
1889	11	65	11	1	..	..	..	..	..	..	..	..	..	88
1890	16	41	6	1	..	..	..	..	..	..	..	..	..	64
1891	11	32	10	2	..	..	..	..	..	..	..	..	1	56

The mortality from croup for the past eight years is shown in table No. 44. In 1891 there were 56 deaths from this cause, a less number than has been reported in any one year since 1884. This is also a disease of childhood chiefly, as will be seen by a study of the table.

TYPHOID FEVER.

TABLE No. 45.

Mortality from Typhoid Fever from 1884 *to* 1889, *inclusive.*

YEARS.	Deaths.	Percentages of deaths to deaths from all causes.	Death-rates per 10,000 living (estimated population).
1884	137	2.21	3.81
1885	136	2.19	3.75
1886	194	3.01	5.31
1887	134	2.06	3.64
1888	150	2.18	4.04
1889	161	2.40	4.30
1890	143	1.94	3.79
1891	170	2.42	4.48
Total	1,225		
Average	153		

The above table shows the mortality from typhoid fever from 1884 to 1891, inclusive, with percentage to deaths from all causes and the death-rate to each 10,000 of the living population. In 1891 there were returned 170 deaths from this disease, a larger number of decedents than had been recorded in any one year since 1886. The average yearly deaths for the past eight years is 153.

SCARLET FEVER.

TABLE No. 46.

Mortality from Scarlatina from 1884 *to* 1891, *inclusive.*

YEARS.	Deaths.	Percentages of deaths to deaths from all causes.	Death-rates per 10,000 living population.*
1884	52	.83	1.44
1885	53	.85	1.46
1886	21	.32	.57
1887	26	.40	.70
1888	34	.49	.91
1889	18	.26	.48
1890	16	.21	.42
1891	13	.18	.34
Total	233	.....	.....
Average	29	.....	.....

* Population estimated for all but census years.

Table No. 46 gives the number of decedents returned since 1884, with percentages. This table is significant in showing what has been done by restrictive action. For a further discussion of this subject see the article on "Scarlet Fever" elsewhere in this report.

MEASLES.

TABLE No. 47.

Mortality from Measles from 1884 *to* 1891, *inclusive.*

YEARS.	Deaths.	Percentages of deaths to deaths from all causes.	Death-rates per 10,000 living population.*
1884	3	.04	.08
1885	45	.72	1.24
1886	18	.28	.49
1887	39	.60	1.06
1888	55	.80	1.48
1889	16	.23	.42
1890	9	.12	.23
1891	19	.26	.50
Total	204	.....	.....
Average	26	.....	.....

* Population estimated for all but census years.

This table shows the mortality from measles from 1884 to 1891, inclusive, with percentage of deaths to total mortality; and the death-rate to each 10,000 of the living population.

In 1891, there were 19 deaths returned from this cause. Five were under 1 year of age; 6 between 1 and 5; 2 between 5 and 10; 1 between 30 and 40; 1 between 40 and 50; 1 between 60 and 70; and 1 age not stated.

SOME FOODS AND THEIR ADULTERATION.

BY PROF. E. R. ANGELL, DERRY, N. H.

The state board of health of Massachusetts, during the year ending September 30, 1891, examined 2,144 samples of food, exclusive of milk, and found 567 to be adulterated; 2,726 samples of milk were examined, of which 1,097 were below standard or otherwise adulterated; of 424 samples of drugs examined, 72 were adulterated, or did not conform to the statute.

Following is a list of most of the kinds of food which make up the 2,144 samples; the first number in each case gives the total number of samples taken, and the second number, the number of adulterations found:

Olive oil, 17–12; butter, 191–96; cheese, 21–0; lard, 35–18; molasses, 138–13; maple sugar and syrup, 59–19; honey, 41–9; sugar, 9–0; vinegar, 45–13; confectionery, 38–2; cream of tartar, 375–59; baking powders, 17–11; saleratus, 6–0; canned vegetables, 111–98; mustard, 109–31; cayenne pepper, 39–8; white pepper, 34–6; black pepper, 229–53; mace, 11–1; cassia, 103–14; cinnamon, 8–0; cloves, 130–15; allspice, 64–4; ginger, 54–4; coffee, 141–64; tea, 49–0; chocolate, 4–0; cocoa, 3–0.

These figures in many cases, of course, do not represent the true condition of the market. Dr. Abbott, secretary of the board, says: "No conclusions can be made from these figures, relative to the actual state of the markets, with reference to the question of adulteration in the case of any given article, since in many instances the samples were collected in consequence of a special line of investigation. For example,

nearly all of the canned vegetables referred to in this table were samples of French importations suspected to contain sulphate of copper (blue vitriol) as a coloring material. Again, in the case of butter, the inspectors have become, by years of experience, familiar with the conditions and circumstances under which its substitute, oleomargarine, is fraudulently sold, and hence they select such cases for examination."

On the other hand, without doubt, the table in case of some articles of food, especially where but few samples were taken, understates the actual extent of adulteration.

Regarding the cost of adulteration to the people, we quote from Bulletin No. 25, issued by the United States Department of Agriculture, printed, 1890: "The total value of the food consumed in the United States, according to the 'American Grocer,' is at a low estimate, $4,500,000,000. The 'Grocer' estimates that 2 per cent of this is adulterated, or $90,000,000, of which 90 per cent is of a character non-prejudicial to health (this is exclusive of meats and milk). Accept for the sake of argument this statement, and the result shows that there is $9,000,000 worth of poisonous food products put annually on the country, and $81,000,000 of fraudulent products. This immense sum of money is simply stolen from the people each year by men who coin fortunes by cheating the consumers.

"That this estimate is far below the truth none can doubt for a moment, after the examination of the very able reports made in those States that have attempted to protect their citizens against this crime of adulteration. Take the very conservative estimate of Dr. Abbott, of Massachusetts, of a saving of 5 per cent to the people in the increased purity of food products (to say nothing of the benefit to health and morals). On $4,500,000,000 the annual saving to the country would be the immense sum of $225,000,000. There is undoubtedly a large part of the food products that never leaves the hand of the producer, and, of course, this is not adulterated, and again the wheat and corn production is rarely found adulterated in this country, besides which there are, of course, many

articles manipulated and sold by honest men who would disdain to sell their goods if debased or misbranded. Yet, in spite of all this, undoubtedly the percentage of adulteration, sophistication, and misbranding, largely exceeds, in my opinion, 5 per cent of the whole, and I am confident that 15 per cent would be much nearer the mark. Such an estimate would give the startling figures of loss to the people of this country alone of $675,000,000 a year."

BAKING POWDERS.

It has been estimated that from 50,000,000 to 75,000,000 pounds of baking powder are consumed annually in the United States, and that probably two thirds of this are made from cream of tartar and the remainder from phosphate and alum.

No preparation has yet been found equal to yeast for raising bread. Its great objection is its slowness. To obtain something which will act rapidly causes the demand for baking powders. Bread, when prepared without something of the kind to aerate it or make it light, is heavy, hard, and tough. Such bread cannot be easily separated by mastication into particles sufficiently fine for the ready action of the digestive fluids upon it. Whether yeast, or some form of baking powder is used, bread is made to rise by causing the same gas, carbonic acid, to be disengaged within its mass whereby its particles are forced apart. The baking process hardens the walls of the cell, and the bread is porous and palatable.

When yeast is used, the gas is produced by the action of the ferment upon the constituents of the bread itself, and no residue, or substance foreign to it is left within it; but when baking powders are used, the water added to make the dough, dissolves the chemicals, and a reaction occurs, carbonic acid is set free, and salts result from the combination of the acid with the alkaline base; the salts remain in the bread and are eaten with it. Many suppose that everything is driven off by the process of baking, but this is not so; the gas alone is expelled.

There is no recognized standard for baking powders; consequently to prove some substance in them injurious to health is necessary to establish adulteration.

Bicarbonate of soda, common "baking soda," is almost exclusively used as the substance containing the gas.

Baking powders are conveniently classified according to the kind of acid constituent used. Tartrate powders contain tartaric acid in some form. Phosphate powders contain some form of phosphoric acid. Alum powders contain some form of alum salts. Sometimes a powder is a mixture of at least two of these. The residue which remains in the bread when tartrate powders are used, is the double tartrate of potash and soda, generally known as Rochelle salt, and is one of the components of Seidlitz powders. This residue is the least objectionable of any left by baking powders. The United States Dispensatory says of it: "Given in small and repeated doses it does not purge, but is absorbed, and renders the urine alkaline."

Phosphate powders usually contain the acid in the form of acid phosphate of lime, and the residue resulting from their use consists of phosphate of lime and phosphate of soda. The dispensatory says phosphate of soda is "mildly purgative in doses of one to two ounces." Probably phosphate of lime has the effect of phosphates generally upon the system. They enter into animal tissues as an essential constituent, and for this reason the residue left in bread from the use of phosphate powders might seem desirable rather than objectionable.

The residue left in bread from the use of alum powders consists of hydrate of aluminum, sulphate of soda, and sulphate of ammonia. The objection to this kind of baking powder hangs upon the presence of aluminum salt. The use of alum in bread making is prohibited in countries having food adulteration laws, such as England and France. There are two reasons for this: because it has an injurious effect upon the system; and because it, in some way not understood, improves the appearance of bread made of inferior or even

partly spoiled flour so that it looks as well as if made from much better flour. An English authority says of alum: "Its effect on the system is that of a topical astringent on the surface of the alimentary canal, producing constipation and deranging the process of absorption. But its action in neutralizing the efficacy of the digestive solvents is by far the most important and unquestionable. The very purpose for which it is used by the baker is the prevention of those early stages of solution which spoil the color and lightness of the bread whilst it is being prepared, and which it does most effectually; but it does more than needed, for, whilst it prevents solution at a time that is not desirable, it also continues its effects when taken into the stomach, and the consequence is that a large proportion of the gluten and other valuable constituents of the flour are never properly dissolved, but pass through the alimentary canal without affording any nourishment whatever."

When a baking powder contains more than one kind of acid salt the residue is more complex, but has the general effect of its several constituents.

Tartaric acid uncombined is seldom used in baking powders. The residue produced by its use is tartrate of soda, and the quantity is the least produced by any baking powder; perhaps its physiological effect is about the same as that of the double tartrate of potash and soda.

The reason why tartaric acid is not more generally used in the uncombined state is, doubtless, because its greater activity would cause the powder to deteriorate on keeping. When the bitartrate of potash, cream of tartar, is used, it is necessary to use from 10 to 20 per cent of starch, called filling, to prevent action of the acid salt upon the base to cause deterioration. A certain amount of filling seems to be necessary to all of the powders to keep them.

Now a word about the economics of baking powders. Numerous experiments demonstrate that tartrate powders produce as much available carbonic acid gas as any other kind, if not more. With cream of tartar, baking soda, and

starch, at 35 cents, 6 cents, and 6 cents per pound, respectively, at retail, one pound of baking powder, equal to any on the market, can be made at home, by simply mixing the constituents, for less than the price of one half pound of Royal Baking powder. Thoroughly mix $2\frac{1}{4}$ pounds cream tartar, 1 pound baking soda, and one half pound of starch, and you have $3\frac{3}{4}$ pounds of excellent baking powder at a cost of not more than 88 cents, or a little less than 24 cents for one half pound. One half pound of Royal Baking powder, which is a tartrate powder, sells for about 24 cents and yields about 12.7 per cent of available carbonic acid. Baking powder made according to the above directions yields from 12 to 13 per cent available carbonic acid, consequently its bread raising power is fully equal to that of the commercial article. Cream of tartar, of course, is the expensive ingredient. When sour milk is to be had it can be used to advantage not only in saving the expense of the cream of tartar, but in adding a valuable amount of nutriment to the bread. When sour milk is used, the lactic acid which it contains liberates the carbonic acid gas from the baking soda.

TEA.

No one has better summarized the virtues of tea than Lo Yu, the earliest Chinese writer on the subject; he says, "It tempers the spirits and harmonizes the mind, dispels lassitude, and relieves fatigue, awakens thought, and prevents drowsiness, lightens or refreshes the body, and clears the perceptive faculties."

Jonas Hanway in his essay on "Tea" written in 1756, voices in strong terms the opinion of those who oppose the use of this beverage when he says, "Men seem to have lost their stature and comeliness and women their beauty."

But Dr. Johnson, writing for the "Literary Magazine," the following year, beautifully expresses the sentiment of most tea drinkers, when, as if more doubtful of the evil than of the good, he describes himself as "A hardened and shameless tea drinker, who for twenty years diluted his meals with

only the infusion of this fascinating plant; whose kettle had scarcely time to cool, who with tea amused the evening, with tea solaced the midnight, and with tea welcomed the morning."

Tea exhilarates without intoxicating. It seems to sustain the body under severe muscular or mental exercise without causing subsequent depression; it seems to lessen the waste of the body, and to a certain extent to save food; consequently, it seems to help the aged to retain their rounded form and apparent vigor, and to lengthen the scanty store of the poor.

It is frequently a remedy for nervous headache. But used excessively, it causes sleeplessness and general nervous irritability. Being rich in tannin it diminishes the flow of saliva, and the digestive activity of the stomach and hinders the action of the bowels. The large quantity of tea used by the poor, although it may blunt the tooth of hunger, must be fraught with incalculable future calamity to the consumers, in the form of dyspepsia and nervous disorders.

It is now thought by botanists that an indigenous tea tree found in Assam is the parent of all cultivated varieties. This is much larger than the tea plant cultivated in China, but less hardy. The China tea plant, of which there are two kinds, is an evergreen shrub from three to five feet high. The leaves are about four inches long, alternate, elliptical, obtusely serrated, veined, and placed on short channeled foot stalks.

The venation, serration, and stomata of the tea leaf are very characteristic. The veins do not extend to the edge of the leaf, but each recurves slightly and unites with the vein next toward the point of the leaf, so that if the edge of the leaf were trimmed off, following the outer line of primary venation, it would form a smaller leaf with lobed edges. The serrations are almost lacking in delicate leaf buds, but are very distinct in the full-grown leaf. The under side of the leaf is thickly covered with fine, one-celled, thick-walled hairs; as the leaf increases in age these hairs entirely dis-

appear. The cellular structure of the older leaf is characterized by large, branching, thick-walled, smooth cells; although this structure occurs in some other kinds of leaves, it does not occur in such as would likely be substituted for tea.

Teas are usually designated as black and green. It was formerly thought that each was produced by a different species of plant; but such is not the case; both black and green teas are prepared indifferently from either variety of plant. The difference depends upon the method of curing.

Teas known as flowery pekoe, orange pekoe, pekoe, pekoe souchong, souchong, congon, and bohea are so classified according to the age of the leaf in the order given, flowery pekoe being the youngest. It is not the practice, however, to pick and treat the leaves separately, but to work them together, and then assort them into qualities by sifting.

The manufacture of black tea consists essentially of withering, rolling, fermenting, and firing, different manufacturers introducing various modifications.

After the leaves are picked, they are spread out in a convenient manner to dry; the sun is used in fair weather; artificial heat in cloudy weather. When the leaves become well wilted, soft, and flaccid, they are twisted, and rolled backward and forward over a table until the juice exudes. In China it seems to be an object to remove the juice, but in India, it is soaked up and saved by the spongy mass of leaves.

The leaves are now either rolled up into balls, or pressed together in trays, covered with cloth, and set in a sunny place to ferment. Fermenting is the distinguishing feature of black tea making. During this process many of those changes take place which make it different from green tea. The quality of the tea depends upon proper fermentation; the progress of the operation is marked by the changes in the color of the leaf. When sufficiently fermented the leaves are thinly spread out and sunned for about an hour. This changes the green color to black. The next step is called firing. The leaves are placed in a tray over a charcoal fire, and constantly stirred and turned while the temperature is increased

until all moisture is driven off. They are finally assorted into commercial qualities by sifting.

In the manufacture of green tea the leaves, as soon as possible after picking, are steamed or sweated by exposure to a brisk heat. They are then rolled as in the making of black tea, after which they are spread out in the sun until they take a black tinge. The rolling and sunning may be repeated several times. The tea is next placed in hot pans and stirred briskly until it is too hot to be worked by the hand. Then it is tightly packed in a canvas bag and beaten with a heavy flat stick; in this condition it is left over night. Next day it is fired off in a pan, beginning with a high heat, which is gradually reduced during the nine hours of the operation, the tea being constantly stirred meanwhile. The green color of the tea is developed during the firing.

Some of the differences chemically between green leaves, and green tea and black tea made from the same, are shown by the following, the figures having the same order as the names just given:

Ethereal extract, per cent	6.49	5.52	5.82
Other nitrogen free extract, per cent	27.86	31.43	35.39
Theine, per cent	3.30	3.20	3.30
Tannin, per cent	12.91	10.64	4.89
Soluble in water, per cent	50.97	53.44	47.23
Ash	4.97	4.92	4.93

Most tannin exists in the leaf and least in black tea; but the "other nitrogen free extract" is largest in black tea, and least in the leaf. Doubtless the excess of tannin in green tea partially explains why its effects on the system are apt to be more unfavorable than that of black tea.

Tea contains from 4 to 9 per cent of moisture; from 1 to 3 per cent of theine; from 5 to 15 per cent of tannin; it yields from 5 to 7 per cent of total ash, and 42 to 53 per cent total aqueous extract.

The amount of tea consumed per capita in different countries varies much. In China it is estimated to be about 5 pounds; in the United Kingdom of Great Britain, about 5

pounds; in the United States, 1.33 pounds; in Russia, 0.43 pound; in Holland, 0.91 pound; in Denmark, 0.04 pound; in Victoria, the enormous quantity of 11.99 pounds.

Of all the tea imported into the United States, China furnishes more than half, Japan about two fifths, and India or other British possessions nearly all the remainder.

Adulteration.

When substances are added to tea to increase its weight or bulk, to give strength and color, or to impart a gloss or luster, it constitutes adulteration. Silica and metallic iron, the magnetic oxide of iron, particles of brick, exhausted tea leaves, and the leaves of other plants, those of the willow, sloe, beech, ash, black currant, hawthorne, raspberry, and Paraguay tea, are used to increase the weight and bulk of tea. The presence of silica, iron, and other mineral substances may be inferred by the increased quantity of insoluble ash yielded by the tea. Genuine tea gives from 2 to 5 per cent of insoluble ash. Metallic iron and the magnetic oxide of iron can be detected by a magnet. The addition of exhausted tea leaves is detected by determining the amount of tannin and soluble extract. Not more than 2 per cent of tannin is present in exhausted tea leaves. Nearly 50 per cent of genuine tea is soluble matter, but when exhausted leaves have been added, it is greatly reduced; so that if the quantity of tannin and soluble extract are considerably below the normal amount, the presence of exhausted leaves is strongly indicated.

The detection of foreign leaves is best done by studying their size, shape, venation, and serrations, and comparing them with known leaves. The presence of exhausted and foreign leaves is often disguised by the addition of substances which impart artificial strength and coloring power to the tea, such as catechu, logwood, "lie tea," and salts of iron.

The infusion of tea to which catechu has been added, becomes turbid when cold. This adulterant is often detected by the microscope and by the abnormally large proportion of

tannin present in the tea. "Lie tea" consists of the dust and sweepings of tea and other leaves mixed with mineral substances and agglutinated into little masses with rice water, starch, and gum. It is an adulterant of gun-powder tea. Hot water dissolves the adhesive substances and liberates the other constituents. Starch is detected by the microscope and by the iodine test. Tincture of iodine colors starch blue. The mineral matter is usually discovered by the largely increased quantity of ash; for "lie tea" sometimes yields as high as 40 per cent of ash. The iron salts are used to give a dark color to the tea, and are readily detected by chemical means. Add a few drops of hydrochloric acid to a little of the tea infusion and boil, then add a drop of ferrocyanide of potash solution; if iron is present, a blue color will be produced. If the addition of a few drops of sulphuric acid to the infusion of tea produces a red coloration, it shows the presence of logwood.

The form of adulteration known as "facing," is probably more extensively practiced than any other. This attempt at artificial production of the natural color, is for the purpose of concealing the presence of foreign leaves and for giving to poor and damaged teas the appearance of better quality than they possess. Substances used for the purpose are Prussian blue, turmeric, indigo, plumbago, gypsum, and soapstone.

Facing is usually readily detected. The glossy and deep green color often noticed in green tea is entirely different from the natural color of the leaf. Shake the leaves in a glass cylinder with warm water and examine the detached particles under the microscope. Prussian blue appears as transparent particles of a brilliant blue color; turmeric appears yellow; plumbago, like bright particles; gypsum and soapstone, like earthy and more or less opaque particles.

Chemically, Prussian blue is detected by warming the tea with caustic soda, acidulating the filtrate with hydrochloric acid, and adding ferric chloride, when a deep blue color is produced.

If the sediment in the glass cylinder appears blue, treat it

with a strong solution of caustic soda or potash; the blue color of Prussian blue will be discharged, but not that of indigo; if turmeric is present it will be colored brown. Plumbago can be detected by treating the tea with water and evaporating the infusion, when it will be deposited on the bottom of the dish as a dark, shiny coat.

Pure tea should not turn black when digested with an aqueous solution of hydrogen sulphide, nor give a blue color with solution of ammonia. If these tests give no reaction, lead and copper are absent.

COFFEE.

The coffee tree is a native of Abyssinia, Western Africa, and perhaps Arabia. At present it is grown in many tropical countries. In the wild state, it grows from twelve to twenty feet high; but when cultivated, it is usually topped at from six to ten feet in height, so that the branches are kept near the ground. The leaves are evergreen, oblong-ovate, four or five inches long, opposite, shining, and leathery. The flowers are small, white, and very fragrant. They are situated in the axils of the leaves. The fruit is succulent, dark red when ripe, and contains two cells lined with cartilaginous membrane, each containing a single seed. The seeds are hard, and of semi-elliptical shape. They are the coffee beans or berries of commerce from which the beverage called coffee is prepared after roasting at a temperature of about 200 C.

In the process of roasting the berry loses considerable weight, but increases in bulk and aroma.

The percentage composition of unroasted and roasted coffee is about as follows, respectively:

Moisture, 11.23, 1.15; fat, 13.27, 14.48; crude fibre, 18.17, 19.89; total ash, 3.92, 4.75; caffeine, 1.21, 1.24; albuminoids, 12.07, 13.98; sugar, 8.55, 0.66; other nitrogen-free extract matter, 33.79, 45.09.

Adulteration.

Inferior coffee is sometimes treated by a process called facing to improve its appearance. South American coffees are often made to imitate Java by exposure to a high, moist heat, which changes the color from green to brown. Another method of preparing imitation Javas is to decolorize the raw coffee by means of lime water, and then give it the proper color by roasting, or by the use of azo-orange.

The weight which is lost in the first part of the process is regained by steaming, and then a coat of glycerine, palm oil, or vaseline being added prevents evaporation.

Coffee which has been damaged by sea water is often caused to imitate Java by this method.

Coffees are sometimes faced with Prussian blue or indigo, lead chromate, Silesian blue, burnt umber, Venetian red, drop black, yellow ochre, and charcoal.

Facing can often be detected by shaking the coffee with water, and examining the sediment microscopically, or chemically. Some of the coffee should be burnt, and the ash examined for the several metals liable to occur, such as lead, copper, tin, and arsenic. Moist preparations of coffee preserved in tin should be examined for tin and copper.

The root of the chickory plant is a common adulterant of coffee. Ground chickory sinks in cold water quickly. It is soon softened and colors the water almost at once; but ground coffee floats, giving no color. Chlorinated soda bleaches chickory, but acts feebly upon coffee. Pure coffee, if over-roasted, is apt to sink in water quickly. Chickory is often treated with fat when used as an adulterant, so it will float. Consequently, the water test alone is not always reliable. Chickory in coffee is readily and certainly detected by means of the microscope.

The determination of chlorine in the ash furnishes a valuable indication. The ash of coffee contains from 0.03 to 0.15 per cent of chlorine, while the ash of chickory contains as high as 0.28. There are certain precipitation and color

reactions with certain chemical reagents which are of value in the hands of one experienced with their use.

Other adulterants often used are the various cereals — corn, wheat, barley, oats, rye, pease, beans, canna seed, sawdust, oak bark, dandelion root, Mogdad coffee, Mussaenda coffee, cocoa husks.

The cereals, and pease and beans are generally detected by the presence of starch, and the kind of adulterant by the peculiar appearance of its starch under the microscope. Cereals sink in water imparting little or no color to it, though coffee deprived of its oil, or cereals treated with oil, reverse the result.

The mean ash of cereals is lower than that of coffee. Wheat gives about 1.9 per cent of ash; corn, 1.5; barley, 2.9; oats, 3.2; rye, 2.1; while coffee gives about 4.75 per cent of ash; consequently the determination of the ash gives valuable indication of adulteration.

Pease and beans are determined by the appearance of their starch; pease color cold water quickly, and for the most part sink in water. Coffee is quite tough; pease are brittle, as easily determined by placing a particle between the teeth.

The microscope is an indispensable instrument for the detection of adulteration. Slides prepared from the genuine article, and compared with slides prepared from the suspected article, to the eye of the experienced microscopist, in most cases, quickly tell the truth.

Coffee is sometimes glazed with sugar or syrup before roasting, for the sake of retaining the moisture, and so increasing the weight. To show what profit there is in this process to the roaster and disadvantage to the consumer, it is only necessary to call attention to the fact that unroasted coffee contains about 11.23 per cent of moisture, and roasted coffee only about 1.15 per cent. While coffee glazed with sugar or syrup contains about 10 per cent of moisture, and in addition to this, nearly 3 per cent more soluble matter adhering to the bean, and 1 per cent more of sugar than the coffee naturally contains, so that, at least, one eighth part is fraud. This

kind of adulteration may be detected by soaking the coffee in water. If it has been glazed with sugar, the caramel formed by roasting will color the water quite strongly. If the colored liquid is evaporated to dryness, weighed, incinerated and weighed, the loss in weight gives the organic matter adhering to the coffee bean, and this, compared with the amount of organic matter adhering to unsophisticated coffee tells the truth.

Of course, it is comparatively easy to adulterate ground coffee without its being detected by the average consumer, and to grind coffee before his eyes, seems to be a sufficient guarantee of its purity. But human avarice and ingenuity have assayed to equal the occasion. Imitation coffee beans are manufactured. Special machinery is used for molding them. Some of these imitation coffee beans are composed of wheat flour alone; some of wheat flour, coffee, and chickory; some of wheat, oats, buckwheat, beans, and chickory; some of wheat flour and sawdust; some of wheat, rye flour, and corn; some of sugar, dextrine, and fat, then glazed; some of coffee grounds, chickory, and pease; some of chickory, flour, and sulphate of iron, and doubtless many other similar substances are used. The artificial beans are roasted, and when mixed with the genuine, the deception is quite complete.

To detect this adulteration, test with water. Genuine roasted coffee beans will float. Roasted imitation coffee beans usually sink. Sometimes over roasted coffee sinks and imitation coffee floats. These are exceptions, however. Again, test with a solution made of 40 measures of alcohol and 60 measures of water. The beans which sink in this should be subjected to further examination; but it should be remembered that as the delicacy of the gravity test to detect the imitation beans is increased by this method, so the liability to error is made greater, because certain coffees will sink in a liquid of this density.

The genuine coffee bean always has some of the thin membrane with which it was originally surrounded, still adhering in the cleft. This has not yet been imitated. An examina-

tion of quite a number of beans for this distinctive feature will always tell whether imitation beans are present or not.

If a section of a genuine coffee bean be examined, it will be found that the structure lacks uniformity, while the imitation bean has a uniform structure. The imitation beans generally contain starch; genuine coffee never contains it. Microscopic examination will detect not only the starch, but chickory and similar roots, if present.

The term coffee extract sounds well. It gives the impression that the soluble and nutritive portions of coffee are condensed and in convenient form for use; but here adulteration, without easy detection, is made vastly more possible, and whether the extract is adulterated or not, it is apt to contain poisonous metals dissolved from the can containing it. Samples are found which contain cereals but no coffee, others contain about the same amount of caffeine pound for pound as exists in genuine coffee. Of course, there are some genuine samples. It seems to the writer that this industry ought not to be encouraged on account of the greater cloak it affords for fraud.

COCOA.

The cocoa tree is a native of Mexico. It is now cultivated in the various Central American and South American states, and the West Indies. It flourishes best within the 15th parallels of latitude, and requires a rich, well watered soil, moist atmosphere, free from cold winds and violent storms.

The young plants are very delicate and are best reared in nursery grounds till they are 18 inches high. After planting out they are protected from the sun and winds by cultivating more hardy food yielding plants among them. The cocoa tree begins to bear in the fourth or fifth year and continues productive for thirty or forty years.

When fully grown the tree is about 18 feet high. The leaves are large, smooth, and glossy, elliptic-oblong, and cuminate in form. They grow mostly at the ends of branches but sometimes spring directly from the trunk. The flowers are small, and grow in clusters on the main branches and the

trunk. This makes the fruit appear as if artificially attached to the tree. Generally but one fruit grows from a cluster of flowers. The fruit, or pod, is shaped some like a cucumber. It is from seven to ten inches long, and from three to five inches in diameter. It has a hard, thick, leathery rind of a rich purplish yellow color, externally rough, and marked with ten very distinct longitudinal ridges. The interior of the fruit has five cells, in each of which is a row of from five to ten seeds, or beans, so that each fruit contains from twenty to forty seeds which constitute the "cocoa beans" of commerce. The beans are egg-shaped, one half to three fourths inch long and one fourth to one half inch broad. When first removed from the pod, they are colorless; but on drying with exposure to air and light, they become golden yellow to red or brown in color, and hard and brittle. The trees carry buds, flowers, and fruit in all stages of growth at all seasons of the year, so that ripe fruit may be gathered any time; but generally the harvests are in June and December.

After the seeds are removed from the fruit, they are placed in boxes, or casks, and allowed to ferment. Sometimes the fermenting process is accomplished by throwing the seeds into trenches, and covering them with earth. It is more customary now to bury the seeds in casks so that the earth does not come in contact with them. The fermenting process requires great attention, for on it depends the flavor and quality of the product. In the process, the beans lose much of their acridity and bitterness, and become mild and aromatic, having a pleasant, slightly bitter taste.

The cocoa bean contains from 35 to 54 per cent of fat; from 0.5 to 2 per cent of theobromine; from 5 to 15 per cent of starch; from 3 to 6 per cent of celulose; from 3 to 5 per cent of ash; from 7 to 20 per cent of nitrogenous matter; a small quantity of cocoa red, and a little of several other substances.

In the manufacture of cocoa, the beans are roasted in a large revolving cylinder. This changes the starch into dextrine and forms its peculiar empyreumatic aroma. They are

then crushed and reduced to the form of nibs; the shells, or husks, are separated by the action of a powerful fan blast. The nibs, after being sifted, and all the hard and poor pieces removed, constitute the simplest and purest preparation of cocoa sold; they require prolonged boiling to completely disintegrate them; consequently, they are generally ground into meal, or reduced to powder. "Soluble cocoa," as distinguished from chocolate, consists of the meal or powder formed by grinding the nibs. When this is pressed into cakes it constitutes chocolate. When sugar, vanilla, and spices are added, it forms what is termed "sweet," "vanilla," or "spiced" chocolates. These are sold both in the form of powder and cakes. Soluble cocoa, which is sold under such names as homœopathic, Iceland moss, and pearl cocoa is made by grinding the nibs in a heated stone mill, and while the meal is in a pasty condition, it is thoroughly mixed with sugar, arrowroot, or other inferior starches. The mixture is ground to a fine powder, and sold under various names as given above.

Many manufacturers seem to tax their skill in ostensibly producing an easily digestible and highly nutritious article; but often in so doing they remove the fat, destroy the aroma and flavor by the use of chemicals, and, after all, the product is of doubtful food value.

Cocoa is much richer in nutritive substances than tea or coffee. Both the soluble and insoluble portions of cocoa constitute a part of the beverage, while only the soluble parts of tea and coffee are taken into the system.

The term "soluble cocoa" is by no means correctly applied. No pure cocoa contains a very considerable proportion of matter soluble in water. The term seems to denote a preparation that does not allow its insoluble matter to precipitate in the beverage made from it. This may be accomplished by very finely powdering the cocoa, or by mixing with it sugar, or some soluble substance which increases the specific gravity of the beverage and so prevents precipitation.

Cocoas prepared with alkalies for emulsifying the oil with

the specious purpose of producing easily digestible cocoas, are very injurious. The stomach does not bear soap well.

No food material offers more favorable conditions for adulteration than cocoa preparations. Both the color and form in which it is prepared for market, easily conceal the adulterant.

The adulterants usually added to increase the weight and bulk are sugar, wheat, and potato starch, rice, arrowroot, acorn, rye flour, ground peanuts, raw malt, sawdust, spices, sand, clay, and foreign fat, to make up the normal quantity of fat, or to give the mass plasticity for molding. The coloring substances used are ferric oxide, potassium chromate, copper sulphate, nickel sulphate, and sometimes finely powdered tin is used to give a luster.

The husks, when not properly removed, or when added to increase the weight and bulk, are an adulterant. Being of a coarse and rough nature, the husk irritates the alimentary canal, consequently it is a very injurious adulterant.

The removal of a part of the cocoa fat is a frequent adulteration. There is strong temptation to do this, because cocoa butter is quite expensive. The removal of the fat deprives cocoa of a great part of its nutritive value. The best way of detecting its removal is to estimate the quantity of fat in the sample by means of ether. If foreign fat has not been added, the quantity present shows the extent of adulteration with other substances. The foreign fats used for adulterating cocoa are usually cocoanut butter, animal fats, margarine, cotton seed oil, and sesame oil.

The determination of the ash furnishes a most valuable indication of adulteration. If the ash is below normal, adulterants low in ash have been used, such as starch and flour. If the ash is above normal, it shows removal of fat, the addition of mineral matter, or the use of alkaline carbonates. The use of fixed alkalies in the process of manufacture is detected by estimating the alkalinity.

Microscopical examination reveals the presence of foreign starches, husks, flour, spices, and often many other adulter-

ants, or gives a clue to their detection. Sometimes it is advisable to remove the fat and bleach the cocoa before making the microscopic examination. This is done by washing with ether, then triturating in a mortar with chlorinated soda until sufficiently bleached. Sugar is detected by polarization. Starch may be inverted by boiling with sulphuric acid and the resulting sugar estimated by the polariscope. Both starch and sugar as adulterants of cocoa are used to a deplorable extent.

The various coloring substances, if not otherwise discovered, are detected by chemical methods.

In the detection of adulteration, the determination of theobromine, the alkaloid of cocoa, seems to be of little use, since its quantity varies so widely in pure cocoas.

Theobromine is very closely related to the alkaloid caffeine, or theine, of tea and coffee, and has similar effects on the system. The value of the three popular beverages, tea, coffee, and cocoa, depends largely upon their respective alkaloids, by the virtue of which they appear to have the power "to cheer and not to inebriate." They all were introduced into Europe about the middle of the seventeenth century. The Spaniards first used cocoa, and it is still consumed more largely in Spain than in any other European country.

The historian Prescott says Pizarro, as he sailed along the Pacific coast, saw "hillsides covered with yellow maize and the potato, or checkered in the lower levels with blooming plantations of cacao." The same writer also says the Mexican emperor Montezuma "was exceedingly fond of it, to judge from the quantity, no less than fifty jars, or pitchers, being prepared for his own daily consumption."

The earliest mention of its use in England is said to be an advertisement in the "Public Advertiser," June 16, 1657: "In Bishopgate Street, in Queen's Head Alley, at a Frenchman's house, is an excellent West India drink called chocolate, to be sold, where you may have it ready at any time and also unmade at reasonable rates."

The amount of cocoa products and preparations imported

into the United States for the year ending June 30, 1890, was 19,894,130 pounds, valued at $2,859,642.

Without entering further into details, it may be interesting to enumerate some of the substances which have been used as adulterants of some of the spices.

Pepper has been adulterated with ground crackers, rice, mustard hulls, charcoal, cocoanut shells, cayenne pepper, bran, the starches of cereals, and potatoes, sago, linseed, sawdust, gypsum, pepper dust and sand; mustard, with flour, turmeric, cayenne, peas, yellow corn meal, ginger, gypsum, chromate of lead, and yellow lakes; cayenne pepper, with ground rice, flour, salt, Indian meal, red lead, and oxide of iron; ginger, with turmeric, cayenne pepper, mustard hulls, cereals, and peas; cloves, with spent cloves, clove stems, minerals, roasted shells, wheat flour, and peas.

Prof. S. A. Latimore, of New York city, in a report on the adulteration of spices, says: "The spices present an inviting field for the exercise of fraudulent arts. They are almost universally sold in the form of fine powder and in opaque packages which do not admit of easy examination on the part of the purchaser. Consequently any cheap substance which may be easily pulverized to a similar degree of fineness, and which possesses little distinctive taste or odor of its own answers the purpose; so that the list of adulterants for this class of articles is naturally very large. The adulterations found in the samples now under consideration may be classed into four groups: first, integuments of grains of seeds, such as bran of wheat and buckwheat, hulls of mustard seed, flax seed, etc.; second, farinaceous substances of low price, such as are damaged by the accidents of transportation or long storage, such as middlings of various kinds, corn meal, and stale ship's bread; third, leguminous seeds, as peas and beans, which contribute largely to the profit of the spice mixer; fourth, various articles chosen with reference to their suitableness for bringing up the mixture as nearly as possible to the required standard of color of the genuine article. Various shades, from light colors to dark browns, may be obtained by

the skillful roasting of farinaceous and leguminous substances. A little turmeric goes a great way in imparting the rich yellow hue of real mustard to a pale counterfeit of wheat flour and terra alba, or the defective paleness of artificial black pepper is brought up to the desired tone by the judicious sifting in of a little finely pulverized charcoal. * * *

It is probably not so widely known as it should be that the demand for the materials for adulteration has called into existence a branch of manufacturing industry of no insignificant magnitude, having for its sole object the production of articles known as "spice mixtures," or "pepper dust." The use of "pepper dust," or, as the article is commonly designated, in the technical language of the trade by its abbreviation, "P. D.," is a "venerable fraud."

All enquiries and investigations in the matter of food adulteration show that it is largely practiced. In countries where there is no law against it, or where the law is poorly enforced, it is, of course, most extensively carried on. Its first cause is, because it is a money making business; its second cause is, because the ignorance of the public demands cheap articles. A Canadian analyst comments on the subject thus: "But have not the producers of the sophistications some justification? Is not the supply of a demand which, undoubtedly, has existed, a justifiable enterprise, whatever that demand may be, so long as it is within the law? Ignorance does, undoubtedly, demand cheapness, and a demand thus ignorantly made is only too surely supplied, and hence the need for costly legislation to protect an ignorant and thoughtless public against itself, for it does demand the very goods which the analyst must condemn and the vender be prosecuted and fined for selling, whereas the public's reckless ignorance is the chief cause and should suffer some measure of the penalty. It is time that, through the operation of this act, such ignorance should be cleared away, and the public be enlightened and awakened to its own true interest." But let opinion be as it may, this is certain, that if there were not more money in selling cheap and adulterated articles

than in selling the genuine, then they would never be sold. Massachusetts has a law requiring that the word "compound" should be placed upon the label of all articles which contain foreign substances mixed with them; but the ingenuity of the designer and printer have been taxed to the utmost to conceal the word either in the printed description, or in the embellished margin. Sometimes it is printed in such small letters, or with so faintly colored ink, that it is quite invisible.

The public does not demand cheap goods in the sense of adulterated articles, but in the sense of much of the genuine for little money. The avaricious producer and vender take advantage of the opportunity to practice deception.

Among the results are the following: the enriching of the few and the impoverishing of the multitude; nervousness, dyspepsia, and generally impaired health of the masses; and, last but not least, corruption of the principles of truth and morality. On account of the fraudulent practices of some, others are led to believe that they, too, must be dishonest, to hold their own in the world. The tendency is toward the general confusion of right and wrong.

New Hampshire has been a dumping ground for cheap and adulterated foods. The unprincipled vender has reaped here a rich harvest. Let these things cease to be; let the legion of attendant evils withdraw; for our food is the first great good; all else is dependent thereon.

THE GROUND OF SAFETY.*

BY PROF. R. C. KEDZIE, LANSING, MICH.

It is a vigorous and suggestive expression when we speak of *our mother earth*. Sprung from the dust, we live upon her bosom, and draw our supplies from her ample stores; and when "life's fitful fever" has burned itself out, our ashes drift back to their original source. Let us, then, humbly accept the fact that as regards our physical existence we are of the earth, earthy, and that we shall never free ourselves from these fetters of clay till mortal shall put on immortality.

Though we tread the soil beneath our feet, yet in an important sense it is for us the physical basis of life. While water is the type of treacherous instability, the solid earth represents confidence and safety; to have our feet on solid ground is to be secure. In times of flood and shipwreck our confidence in *terra firma* is fully brought out. Yet even this implicit trust may be shaken. It is said that no form of danger begets such overwhelming terror in man and beast as the earthquake, when the very *ground* of our security becomes a source of peril. We tremble before the thunderbolt and tornado, we turn pale under the withering wings of the pestilence, but the soul dissolves in terror with the heaving throb of the earthquake. Thus, under uncommon circumstances the *ground of safety* has conditions, and is to be accepted with limitations.

The noblest physical fact in nature is life, for it is the gift of God. If life is noble then the physical conditions of life

* A paper read before the American Public Health Association, at its annual meeting in the city of Mexico, November, 1892.

cannot be ignoble. To turn his thoughts for a time to the physical conditions of life is wise in man, because continuance in life is conditioned upon and limited by its physical surroundings. The ordinary conditions which modify and even limit the common life of the human race demand serious consideration. Common life is a tame and uneventful theme for discussion. The uncommon life of the great, of heroes and statesmen, of generals and admirals who scourge the earth and vex the sea, the rich and powerful who live the uncommon life — this has a fascination for us all, in comparison with which common life seems mean and dull, just as our eyes light up as we gaze upon the gorgeous colors of the rainbow, forgetting the common light of day. But as it takes all the colors of the rainbow to make the common light, so all heroisms and excellence go to make up the common life. In its entirety and intrinsic value, common life is more valuable than all chivalry, romance, oratory, and poetry, just as the ocean is grander and weightier than all the clouds which spring from her bosom only to float in lofty disdain through the fields of air. All honor to common life because it is common, and a reverent study of the conditions for its betterment.

THE VALUE OF HEALTH.

Next to life, the most precious possession is health — the harmonious coördination of all internal and external physical forces to secure the well-being of the individual. The conditions of health have been laid down as pure air, pure water, and pure food. These three "P's" are prime factors of health. Pure life may well be added to the list, and even then all the conditions of healthy living have not been named. Atmospheric temperature and moisture are controlling forces in climate, and have intimate relations to health. The fact that the human body amid wildly conflicting changes of temperature must still maintain the heat of 98° F. — that to fall much below or rise much above that temperature causes disease, and if prolonged may cause death; and the further fact that many processes of secretion, excretion, and assimilation

are delicately balanced against each other to obviate the effect of marked changes of temperature, all indicate the controlling influence of temperature over health and even life. One writer has tersely said, "Heat is life, cold is death."

THE SOIL IN RELATION TO HEALTH.

Since the soil must affect the composition of the air overlying it, has a profound influence upon the water contained within it, and has a marked control over local temperature, it becomes evident that the soil and its physical condition must have a marked influence on the health of the inhabitants.

SURFACE DRAINAGE.

In Michigan, the drainage of swamps and marshes, removing all stagnant surface water, has been so promotive of the general health that no one now questions its benefit. In a State where one ninth of the land was indicated upon the original surveys as swamp, the benefit of surface drainage was most obvious. Within my own recollection the malarial diseases of my State have been reduced one half, and the most potent factor in this reduction was drainage of swamps. No law ever placed upon our statute book has been productive of more good and less evil than the law providing for compulsory drainage, where each land owner was made to bear his just part of the expense, and no churl could block the draining of a whole neighborhood, because he chanced to control the outlet. This law has paid the State tenfold the cost by reclaiming a large area of once worthless land, and it has paid a hundred-fold in protecting the public health.

UNDERDRAINAGE.

Surface drainage needs no advocate to-day, and I call your attention to a form of draining equally necessary, but the need for which is not so obvious. I refer to the underdraining of soils whose surface appears to be reasonably dry, but whose deeper recesses are full of stagnant water. This *ground-water*, as it is called by the Germans, is never to be mistaken

for soil moisture or water held in the soil by capillary action, but is the free water of the soil, which will flow under the action of gravity. This ground-water diminishes in a marked degree the agricultural capabilities of the soil, reducing the temperature, preventing soil oxidation, arresting the elaboration of plant food, and preventing the spreading of the roots in the soil, because the roots of most cultivated plants will die in stagnant water. I do not propose however to discuss the agricultural value of soil drainage.

GROUND-WATER AND HEALTH.

The influence of ground-water on health is even more important than its influence on crops. It matters not how fertile the soil may be, if the farmer, by reason of sickness, is unable to sow the seed and gather the golden grain. The soil that cannot raise life-supporting crops may yet produce death-dealing disease. The careful researches of Pettenkofer of Germany, of Bowditch of Massachusetts, and many other sanitarians reveal the close relation between the prevalence of pneumonia, consumption, and low forms of fever, and the approach of the water line to the surface of the soil. An investigation into the causes of an outbreak of diphtheria in New York, in 1872, brought out the fact that many of the old water courses and natural springs had been filled in years before, without making provision for draining the soil, and the disease seemed to be especially prevalent along the lines of these old water courses. In an outbreak of cholera in Dublin, in 1866, Dr. Mapother says two thirds of the deaths took place on or close to the old water courses that had been converted into sewers or filled up with mud. Objection may be made that these diseases are caused by specific germs, yet these germs can propagate only in a suitable soil, and they find this in a body weakened by unhealthy surroundings.

I call special attention to the influence of ground-water because people are only beginning to realize how profound is the influence of ground-water on the public health. This influence is exerted directly in three ways:

1. By making the soil and the air above it cold.
2. By making both soil and air damp.
3. By generating malaria.

Indirectly the ground-water is the predisposing cause of a large number of diseases.

Let us have a little dry discussion on this subject from a meteorological standpoint, using as data the following table of average rainfall by months at the Michigan Agricultural College for thirty years past.

MONTHLY AND ANNUAL RAINFALL.

	Inches.	Millimetres.
Rainfall in —		
January	1.86	47.244
February	2.11	53.594
March	2.56	65.024
April	2.40	60.960
May	3.08	78.232
June	3.77	95.758
July	3.38	85.852
August	2.81	71.374
September	3.10	78.740
October	2.59	65.786
November	2.23	56.642
December	1.96	49.784

Year, 32.85 inches; 838.390 millimeters.

This is the average rainfall in central Michigan. When we speak of so many inches or millimeters of rainfall we seem to be dealing with small quantities of matter, but the gross amount is really large; thus one inch or 25.4 millimeters of rainfall means 112 tons of water to the acre, and the annual rainfall at the college exceeds 3,600 tons per acre.

The water which thus falls in rain may be disposed of in three ways:

1. Used up by growing plants and evaporated by their leaves and stems.

2. Flow away, either over the surface or by subterranean channels.

3. Evaporated from the surface of the soil.

Any remaining portion will be left in the soil as ground-water.

LOSS OF HEAT.

Let us follow our rainfall in these several ways. The rainfall for six months, April and October, is 18½ inches. Suppose an acre is planted to some crop that will produce twenty tons of vegetable matter, assume Knop's estimate that the crop will evaporate from its leaves during the period of growth 36 times its weight of water; then 720 tons of water — say 6¼ inches of the rainfall — will be used up by the growing crop, leaving 12¼ inches to be disposed of by flowage and evaporation. Suppose that by the combined action of these two agents, 6¼ inches additional of the semi-annual rainfall is disposed of, and the remaining 6 inches would flow away if subterranean channels were present; otherwise this mass of water can only be removed by evaporation. But evaporation is a powerful heat-consuming process. To evaporate one pound of water consumes enough heat to raise the temperature of five and a half pounds of water from freezing to boiling point. The evaporation of such a mass of water lowers the temperature of the soil to a surprising degree, with corresponding loss of the vital forces. To make good this loss of heat by unnecessary evaporation, and restore the normal temperature of such a soil would require the heat caused by burning 56 tons of coal per acre. No wonder the farmer calls such a soil *cold*. To remove this water by flowing instead of evaporating will be a large addition to the available temperature of the soil during the growing season. Every tile that discharges five tons of water a day for six months saves an amount of heat equivalent to seventy-five tons of coal.

CONSERVATION OF HEAT.

Let me vary the illustration for the sake of emphasis, because the loss of heat by evaporation and the saving by drainage is so important that it cannot be placed in too clear a light. Suppose that a tile drain discharges constantly for six months a stream of water whose cross-section is one square inch and velocity two and a half miles an hour, how much coal will be required to evaporate the mass of water thus discharged? More than a thousand tons! Suppose the drain discharges for only six weeks of this period, and is dry the rest of the time, this six weeks' drainage would save the heat equivalent to two hundred and fifty tons of coal. It is a physical necessity that a water-drenched soil should be a cold soil during our so called warm season. The evils springing from this cause are active all the year, but are more manifest in spring and early summer, the period when tile drains would be most active. It is at this season, also, that animal and vegetable life alike demand warmth as they shake off the shackles of winter.

CHILLED AIR.

But the evaporation of so much water-producing cold renders the air over such a soil *damp and chilly*. This result is a physical necessity. This damp and chilly atmosphere has a more serious influence than the simple feeling of discomfort. It has a most depressing influence on the human system, lowering its tone, enfeebling the vital powers, and acting as the predisposing cause of a long list of diseases, some of them the most destructive and incurable known to medicine. The depressing influence of the dampness and chilliness of water-soaked soil is not to be likened to the effect of an occasional wetting as when we are caught in a shower. The chilly dampness of the undrained soil is persistent and unremitting, dragging us down with its cold fingers at all hours, at "noon of day and noon of night," as if we toiled and rested, waked and slept, in a perpetual drizzle of cold rain. It may seem a small force at first, but its persist-

ent, untiring, and relentless pull tells upon the strongest at last, like the invisible fingers of gravity, which finally drag down all to a common level, whether towering oak or lordly hall. This depressing influence is not developed suddenly and distinctly; an hour, a day, a month may show no marked deterioration, else men would flee from such places as from a plague spot; but silently and secretly the sapping and mining go on till the explosion comes in sickness, suffering, and the sleep that is eternal.

SOIL BREATH.

There are certain other conditions secured by drainage of the soil which are essential to the health of the inhabitants, and one of these is aeration of the soil, or the passage of air through the pores of the soil. The air is entirely excluded from water-soaked soil; the entrance of air is prevented and all interchange between the air and soil — all *soil breath* — is prevented. Have you ever thought how *everything breathes — animate and inanimate alike?* You inspire and expire air continuously, and thus keep yourself in good condition, and so do your garments. The air penetrates every fibre of your wardrobe, passing in and out, and carrying out something it did not carry in. If your clothing was impermeable to air you could not tolerate it for an hour. The invisible waves of air wash and purify you every hour.

Let me illustrate this: I cover the bowl of this tobacco pipe with the skirt of my coat, and bringing the stem of the pipe before the candle-flame, you see I can easily blow air through several thicknesses of cloth and sway the flame by the current of air. I do the same thing with buckskin, a felt hat, leather, and everything we wear except India rubber.

If you suppose your clothes do not breathe, place them in an air-tight box and strangle them for a few months, when the musty smell will convince you that your clothes must breathe to remain sweet and wholesome. Even the solid bodies, such as wood and stone, are still washed and infiltrated with air. Here is a stick of red oak a foot long, and

you see I can readily blow air through it. Here is a roll of mortar, such as masons use in plastering walls, and you see I can, with the slightest effort, blow air through six inches of dry plaster.

Not only can the air pass through these bodies, but it does pass under natural conditions, and *plastered walls breathe.* In plastered rooms where the walls have been left undisturbed for some time, you see the position of every beam and joist, and even the lath, by the lighter color of the wall. The part of the wall occupied by the plaster only is more permeable by air, which, in passing through, leaves the dust behind, forming a brown streak. The air holds a fine dust in suspension at all times, which dust will be filtered out and left behind, when this air passes through a plastered wall: where the air passes most rapidly, the most dust will be deposited on our filter, and where less air passes, a corresponding less amount of dust will be deposited: the solid beams and joists prevent the escape of air from the plaster, and thus limit the amount passing through the wall surface next them; the lath will to less extent obstruct the passage of air, while the space between the laths entirely filled with the plaster will most readily permit the passage of air. Thus a glance at our *wall filter*, especially if it has been long in use, will enable us to determine the position of all the framework of the room, concealed by the plaster until revealed by the telltale dust.

Let me digress for a moment to speak of this subject of wall respiration and point out how admirably a plastered wall is fitted to make the walls of a healthy dwelling house, *because it permits the free passage of air, without causing draughts or unhealthy currents.* Let us see how this wall respiration may be affected by some common practices. I am often asked, what is the influence of wall paper on the healthfulness of a room? Let us test this question by seeing whether air will readily pass through wall paper. I place a piece of wall paper over the bowl of this pipe and try to blow air through it, you see the flame is only very feebly swayed, but if I use this filter paper in the same way I readily blow out the

flame. The sizing used to lay on the colors of wall paper, fills the pores of the paper so as to nearly prevent the passage of air, even when we blow forcibly; but with the additional paste used to fasten the paper on the wall, the papered wall becomes impervious to air. Over the plastered mouth of this pipe I have pasted some thin wall paper; it is now dry, but you see I cannot blow the least air through it. *A papered wall is a strangled wall so far as wall respiration is concerned.* When a wall is calcimined, the whiting and coloring material being laid on with a solution of glue, the wall becomes impermeable by air. Here is a pipe, the mouth of the bowl filled with mortar, and this covered with calcimine; it has been thoroughly dried, but only a minute trace of air can be forced through it. The same is true of a painted wall. Here is another pipe filled with mortar; I have very thoroughly whitewashed the exposed face of the mortar, applying two coats of whitewash, yet you see I can blow air through it nearly as easily as through rough plaster.

The amount of air that will pass through this diminutive surface is small, but when we come to apply it to the dimensions of a room, it becomes large. The experiments of Professors Marker and Shultz show that the passage of air through brick walls is by no means difficult. The difference of 20° F. in temperature between out-door and in-door air will cause the passage of about eight cubic feet of air each hour through every square yard of wall surface made of brick.

The soil also breathes. Under proper and sanitary conditions the air passes in and out of the soil with every motion of wind. You will be surprised to see how readily air may be made to pass through soil. Here is a jar seventeen inches high filled with compact, dry soil, the top closed with a doubly perforated cork; through one hole a glass tube passes to the bottom of the jar, but terminates above in a horizontal jet; through the other hole a tube passes to the space above the soil. On blowing into this tube gently you see that the air passes down through fourteen inches of soil, because it escapes freely at the horizontal jet of the other tube, as is shown by blowing the candle flame before it.

WATER STOPS SOIL BREATH.

But all this is changed in the presence of water in these materials. If the walls of the house are wet, the passage of air is prevented. I wet this half inch of plaster and you see I cannot force the air through it. In the same way, if the soil is drenched with water, the passage of air is prevented. I have here a bottle filled with soil saturated with water, and you see how the passage of air is prevented — that the air will pass through seventeen inches of dry soil easier than through four inches of wet soil. Indeed the air will not pass at all through this thin stratum of wet soil, but will readily pass through this thick stratum of dry soil. You thus see that *a drenched soil is a drowned soil;* that all the conservative influences secured by the interaction of soil and air are cut short by the presence of ground-water. You see that such a soil must be unhealthy, aside from the cold and damp quality of air which overlies it, though these are themselves prime factors of disease.

SANITARY DRAINAGE.

Drainage on the large scale for sanitary purposes is almost unknown. Most of our knowledge on this subject is derived from drainage undertaken for agricultural purposes. But whatever the purpose for which drainage is undertaken, the benefit to the public health is always pronounced and unmistakable. Governor Porter, of Indiana, in his address of welcome to this association in Indianapolis ten years ago, referred to the benefits of sanitary drainage in these words: "Underdrainage has everywhere been followed by a great lessening of sickness, and intermittent fever, once so common, has become so rare that it is a good deal less prevalent than in some of the oldest States. Our laws relating to drainage have been recently much improved, and a disposition to relieve the soil in every portion of the State of all excess of moisture tending to lessen its productiveness and to bring on sickness, is everywhere evident."

DRAINAGE OF DWELLINGS.

If the fields require draining, much more the ground for the dwelling. The house you propose to make your home and live in, you surely would not place over such a death trap as a water-logged soil. The ground which is to be the site of a house should be free from stagnant water, both the surface soil and the subsoil. If you do not *know* that the subsoil is dry, dig down eight to ten feet and see if the hole remains dry even if no drought prevails. If water filters into the excavation, remove it by thorough drainage as the first condition for a healthy dwelling.

Some persons assume that a sandy or gravelly surface insures a dry subsoil, and that it is difficult to secure a satisfactory foundation on a clay soil. Both assumptions are erroneous; the porous surface soil may have a water-soaked subsoil, and the stiff clay may be made dry and safe by underdrains. A tract of land in the suburbs of Detroit was so wet and swampy that it was supposed to be nearly on a level with the river, though it was in reality seventy feet above the river. During the wet season it was a preserve for frogs and mosquitoes, and during the dry season the baked and cracked soil seemed to be gaping and yawning with ague and fever. It assuredly seemed an unpromising spot for human habitations. Some enterprising capitalists undertook its reclamation, and sank sewers ten feet below the surface with laterals for every cellar, the whole serving both as surface and subsoil drains. The tract has been built up into a prosperous and healthy portion of Detroit. Examples of this kind might be quoted by the hour. But when houses are built upon retentive and water-soaked soils, while no means are employed to draw off the ground-water or ward off its effects, the harvest of woe is sure, though it may be slow to ripen.

THE MARCH OF EVIL.

To the thoughful mind one of the saddest sights is the endless succession of evils arising from preventable causes. In his inaugural address as Lord Rector of the University of Glasgow, John Bright drew a striking picture of the endless pro-

cession marching on through successive generations of ignorant, impoverished, and embruted men, with their sad-eyed and hunger-pinched wives and children, all continued by the enormous taxes imposed to maintain the conditions and appliances of successful war in times of profound peace. In a less dramatic but no less true light we may draw the lineaments of physical evil, casting its long shadow down the corridors of time. We have histories of races and dynasties, their rise, progress, and decline, the causes which brought them into prominence, and the forces which brought them to their downfall. Why should not a soil have likewise a history of its own and take on a personality as truly as a race? Let us scan the features of such a farm and follow the history springing from its inherent qualities. The surface is somewhat level or gently undulating, the soil a tenacious clay, strong in the elements of enduring fertility if the physical conditions are properly adjusted. The natural drainage is very slight, except that much of the surface water can run off by overflow, but the tenacious quality of the soil prevents all deep drainage; the deeper soil is water-soaked in spring and early summer, and at other times when heavy rains fall; gate and fence posts are heaved by the frost, winter wheat and clover are half uprooted by the same force. Work is late in the spring because the soil is cold and wet, crops are slow to start and slower to ripen. The farmer "has a hard row to hoe." A hopeful and cheerful spirit is conspicuously wanting because he has generally poor success with his crops, "bad luck," and because he has the continuous depression of poor health. The furrows seam his cheeks early, his shoulders stoop when he should stand erect in manhood's prime.

In doors the wife soon fades, the bloom and laugh of happy girlhood give place to the chronic invalidism of motherhood. Children are born only to die, or linger on in joyless ill-health. The family is finally blotted out, unless a surviving son may hand down this heirloom of sorrow to another generation, when the farm passes into other hands to repeat the same story. And thus we see in hopeless succession the genera-

tions of joyless owners pass before our eyes. The doctor, the undertaker, and the sheriff enter in succession to shift the stage scenery, but the same sad drama goes on with little variation.

If nature had only planted a gravel bed under his whole farm, outcropping on some streamside, so the cold waters might laugh and sing on their way to their home in the sea, thus warming up his soil to early fruitfulness, and warming up his soul to the real joy that springs from hope and health, bringing light and laughter to the housewife by letting the tinkling spring-drop replace the scalding tear-drop, how changed the history of such a farm! Competence, and even abundance, come from the grateful returns of his well conditioned soil, as the earth teems with her harvests. Health comes to crown the mercies of the year. His children rise up to call him blessed instead of beckoning him with their shadowy fingers to the spirit land.

Is this all a figment of the imagination? Can you not tell of farms where many of these features can be traced in the water-soaked soil, but finally reclaimed and regenerated by thorough drainage?

Let me close with an illustration given me by the late Bishop Haven:

Two brothers in Vermont, of strong and vigorous stock, and giving equal promise of a long and active life, married wives corresponding in promise of future activity. They both had chosen the healthiest of all callings — farming. One of the brothers built his house in an open and sunny spot, where the soil and subsoil were dry; shade trees and embowering plants had a hard time of it, but the cellar was dry enough for a powder magazine; the house in all its parts was free from every trace of dampness and mold, there was a crisp and elastic feel in the air of the dwelling. The farmer and all his family had that vigorous elasticity that reminds one of the spring and strength of steel. Health and sprightly vigor is the rule, and sickness the rare exception. The farmer and his wife, though past three score, have yet the look and vigor of middle life.

The other brother built his house in a beautiful shady nook, where the trees seemed to stretch their protecting arms in benediction over the modest home. Springs fed by the neighboring hills burst forth near his house and others by his barns; his yard was always green, even in the dryest time, for the life blood of the hills seemed to burst out all about him in springs and tiny rivulets. But the ground was always wet, the cellar never dry, the walls of the room often had a clammy feel, the clothes mildewed in the closets, and the bread molded in the pantry. For a time their native vigor enabled them to bear up against these depressing influences; children were born with apparent vigor and promise, but these one by one sank into the arms of the dreamless twin brother of sleep, under the touch of diphtheria, croup, and pneumonia. The mother went into a decline and died of consumption before her fiftieth birthday, and the father, tortured and crippled by rheumatism, childless and solitary in that beautiful home which elicits the praises of every passer by, waits and hopes for the dawning of that day which shall give him back wife and children, an unbroken family and an eternal home.

"Look on this picture, then on that."

IMPURE AIR, AND VENTILATION OF PRIVATE DWELLINGS.

(*The Orton Prize Essay.*)*

BY HOWARD VAN RENSSELAER, M. D., OF ALBANY, N. Y.

We are very much at the mercy of our atmosphere. If food disagrees with us, we can fast; if we suspect our water supply, we can thirst awhile; but, though we know that the air is contaminated, that it is unfit to take into our lungs, yet breathe it we must, or die.

Twenty times a minute with our inhalations we consume, and with our exhalations we vitiate, about a cubic foot of air. Were we compelled to breathe this air over and over again, we should soon be poisoned and asphyxiated. Fortunately for us, out of doors and in well ventilated rooms nature has provided many ways of diluting and removing the deleterious impurities; but in rooms with doors and windows closed, or in crowded assemblies, the poisonous materials are produced faster than the natural forces can eliminate them. In such places bad effects occur in direct ratio to the number of people present, and the time spent in the polluted air.

Were people killed outright by foul air, its dangers would be carefully guarded against; but its effects are slow and insidious, and often ascribed to other causes. We are careless of its results, because, as its effect at any one time is slight, we grow accustomed to it and disregard its risks; and

* Prize offered by Dr. J. G. Orton, president of the New York State Medical Association, in aid of the popularization of sanitary science. — Printed by permission.

after being in its presence a few minutes our senses become dulled, and do not warn us of the danger. To breathe pure air always we must constantly be on the alert, and in winter we must incur considerable expense. So, though we may be sufficiently educated to appreciate the evils of an impure atmosphere, yet not seeing its marked effects we become indifferent, or begrudge the time, trouble, and expense necessary to provide a sufficient supply of pure air.

But while the immediate effects seem trifling, yet it is true that any prolonged vitiation of this source of supply interferes with the proper working of our organizations and depresses our vital functions.

Statisticians have shown that of the causes of mortality, the most important and farthest reaching is impure air. Further, they state that the death-rate increases regularly with the density of population; and as to occupations, that persons of a sedentary in-door habit are shorter lived than those whose callings demand an out-door life; and still further, that in cities the mortality is greater in those portions where the air is comparatively stagnant, *i. e.*, in narrow alleys, back-to-back buildings, and crowded tenements, than in other parts of the same city.

So high has been the mortality among the tenement-house districts, and so pressing the need for fresh air, that stringent laws have been passed compelling builders to provide a proper amount of breathing space. Such laws are, that no building occupied by more than three families shall cover more than 78 per cent of the lot on which it stands; and that every sleeping, living, and toilet room must have a window giving access to the open air. Since passing such laws, the mortality in these approved dwellings has dropped to the average, or slightly below the average, mortality of the city. In 1869, when there were no improved dwellings for the laboring classes, the death-rate in tenements in New York was 28.35 per 1,000. In 1888, when sanitary laws had been passed, and a few better buildings had been erected, it had fallen to 22.71.

Still better results are shown by the Improved Industrial Dwelling Company of London, which has provided approved homes on a very large scale. Their report of 1891 says that the death-rate in all their dwellings was 11.6 in the 1,000; while the average death-rate in the metropolis was 18.8 per 1,000. At the company's large estate at Bethnal Green it was only 8.5 per 1,000 and the latter, compared with the death-rate of 40 per 1,000 in the large area in the same neighborhood, speaks volumes for the beneficient work which the company was established to carry out. Thus it is proved that not poverty alone, nor bad food, nor unhealthy work increased the death-rate, for all these conditions remained in the approved dwellings, but simply that the supply of air was inadequate in the one case, and abundant in the other.

In 1848, two hundred people were confined in a small space on the steamer "Londonderry," of these, seventy-three died. Every one knows of the "Black Hole" of Calcutta. The mortality in unventilated places is as great among animals as among men. Fifty years ago the yearly mortality of the French cavalry horses rose as high as 197 per 1,000. A few years later, when the stables were properly ventilated, it fell to 27½. The Prussians pay much attention to ventilation; among their cavalry horses it is only 15 per 1,000.

Some time ago in the Zoölogical Gardens, in London, a new room was prepared for monkeys, which was warmed but imperfectly ventilated. Sixty healthy monkeys were placed in the room; of these, in a month, more than fifty had died of consumption, and the rest were sick. The room was then properly ventilated, when it at once became salubrious. Were it necessary, examples like these might be greatly extended.

Let us now consider what we mean by pure air; what the atmospheric impurities deleterious to health are; the effects that they produce; the ways of detecting them; and, finally, how we may avoid them.

AIR AND ITS IMPURITIES.

Pure Air. — Air that is blowing over seas, and on mountains of considerable altitudes, is the purest with which we come in contact.

Such air is composed volumetrically as follows:

Oxygen	20.96 per cent.
Nitrogen	79.00 "
Carbonic acid	.04 "
Water vapor	Variable.
Ozone	Traces.
Mineral salts	"
Organic matter	"

City Air. — The air of cities, in parks, open spaces, and broad streets, in spite of pollution from many sources, is, in respect to the proportion of its gaseous constituents, nearly identical with country air. This seems but natural when we consider the continous dilution and rapid changes of the atmosphere produced by the vast volumes of fresh air which are constantly being moved by the winds; by the cleansing action of the rain in dissolving out and bringing down the gaseous impurities met in its passage, and its thorough washing out of the air of all suspended matter; by the oxidation of oxidizable materials by oxygen and ozone; and by the action of plants in breaking up carbonic acid, setting free oxygen, and storing up the carbon to form new cells.

The main difference in the gaseous composition of the city air and pure air is, that ozone is rarely found in the air of large communities. Ozone is oxygen in another and highly active form, and possesses great oxidizing power. Normally, it is present in pure air in minute quantities only. In the air of cities it comes in contact with so many oxidizable substances that it is exhausted and disappears before it reaches our lungs. The peculiar freshness and vitality of the air which we experience on the ocean and in the country are due, probably, to the presence of ozone in those localities. Air which habitually contains no ozone may be considered to be adulterated.

When, however, we examine the air of narrow alleys, or enclosed courts, or streets bordered by lofty buildings, where the circulation and renewal of air are impeded, and especially where the sun does not shine, we find that oxygen is somewhat diminished, and that carbonic acid is considerably increased. And this, it must be remembered, is the air that many people constantly are accustomed to breathe. Such air is distinctly vitiated.

There are, however, other classes of impurities in the air of cities which are of more importance. These are the temporary suspended matters which go under the name of dust. Dust consists of a great variety of matter, both organic and inorganic. It is the organic matter composed principally of vegetable material, both living and dead, that principally concerns us. Pollen of grasses and flowers, fungi, and especially bacteria form the living, while the dead matter is obtained from fermenting and putrefying food, and also of the dried excreta of our domestic animals, especially the horse. So that in streets paved with asphalt or wood, the dust which blows in our faces and which we more or less inhale into our lungs, is composed almost entirely of horse droppings and bacteria.

Then, from the combustion of coal, great quantities of soot and sulphurous acid are given off. This acid is readily oxidized into sulphuric acid and dissolved from the air by rain, so much so that in the great manufacturing centres the rain is often distinctly acid.

Air of Rooms. — We keep our windows closed a great part of the year — during the winter to keep out the cold, and in the heated term in summer to exclude the heat, so that the circulation and renewal of air in our houses are at these times slight. The incoming air introduced for ventilation may be vitiated or not according to our surroundings; but once in, it may become contaminated in several ways, and unless we take special pains to remove this foul air it rapidly accumulates, becomes offensive and is a menace to health. The sources of contamination are of so great importance that they will be discussed in detail.

1. *Vitiation by Respiration.* — The average adult man, when he is quiet, gives off about .6 of a cubic foot of carbonic acid from his lungs every hour, and also a certain amount from his skin. When he works hard, however, the amount exhaled may be three times that amount. The changes produced by inspired and expired air are these: In passing through the lungs oxygen is absorbed to the extent of about four per cent, and carbonic acid is exhaled in about the same proportion; water vapor is given off to the amount of two pints daily, and with it a considerable quantity of organic matter. The skin is also getting rid of a smaller proportion of the same substance. This moist organic matter very rapidly putrefies, and produces the well known sickening close smell of inhabited, unventilated rooms, and the foetid odor from dirty garments on unwashed people. As it adheres to woolen goods, furniture, and moist substances, it is difficult to remove, and, as it oxidizes slowly, its poisonous effects are continued for some hours. When a person in a room is sick, the organic matter thrown off is increased, and in addition pathogenic bacteria may be set free in the air, which may communicate the same disease to other inmates.

2. *Vitiation by Combustion.* — Illuminating gas, so much used for light in city houses, is a great factor in the vitiation of air, for it is usually allowed to diffuse in the room. There are a number of deleterious products from the burning of coal gas, such as fine particles of carbon, carbonic acid, and carbon monoxide (this latter an inodorous but very poisonous gas), sulphuric acid, vapor, and a few other gases of minor importance. The water gas which is now so extensively used does not contain the sulphur compounds of coal gas, but does contain more of the poisonous carbon monoxide, and so is a more dangerous gas, although all the products of gas combustion are injurious to health. A common gas burner consuming from three to five feet of gas an hour, vitiates as much air as the respiration of three to five men; and as frequently two or more burners are used in a room at one time, the vitiation becomes quite considerable.

Lamps and candles do not produce any sulphur compounds and do not heat the air to the same extent, nor do they form as much carbonic acid as illuminating gas, and for these reasons are healthier.

Cast-iron stoves are frequently a source of contamination. They are easily heated red hot, and when in this condition they are said to decompose any carbonic acid of the room which comes in contact with the heated metal into the poisonous carbon monoxide, and also the carbon monoxide which is formed in the fire in the stove may also pass through the glowing sides. It certainly can leak through badly fitted joints, and having no smell is not readily detected. Then the very hot surface of the stove produces some change in the air, not clearly understood, but probably a burning of the exhaled organic matter. Such air smells burnt and is disagreeable to our senses, and is probably one of the causes of the headache, malaise, and disinclination to exertion experienced in such air.

3. *Vitiation by Effluvia.* — Drains, sewers, and cesspools may be rife in the production of noisome gases and still more dangerous solid ingredients. Sewer air is made up of a mixture of ordinary atmospheric air, various gases of fermentation and putrefaction, and a variable amount of organic matter held in suspension. The gases themselves, some of which are highly offensive, and some inodorous, are probably not capable of producing any definite disease of themselves, but may cause a lowered state of the system, and so predispose to disease should an exciting cause be present. It is fortunate that some of the gases are so offensive, because they act as danger signals, and turn our attention to the source of evil where their presence might not otherwise be suspected. The most important danger of sewer gas poisoning, and the active cause of the disease, lie not in the gases, but in the suspended, invisible, living, organic matter which we call micro-organisms. These are probably the real factors in the production of sewer gas poisoning. They are difficult to detect, and difficult to get rid of.

THE EFFECTS OF IMPURE AIR.

Having seen what the impurities of air in towns and dwellings are, let us study the effects that they produce.

Carbonic Acid. — Much has been written about the effects produced by excess of carbonic acid in the air; and all schemes for ventilation are based on the removal of this offending gas. Yet in itself the amount produced by respiration and combustion in ordinary dwellings is not great, and is probably incapable by itself of producing any morbid effects.

Frequently we read of death from carbonic acid poisoning in persons working at the bottom of wells, vats, mines, etc. In these cases the gas is produced at the bottom of a tube whose opening is at the top only, and where the gas, generated without currents and at the same temperature as the rest of the enclosed air, is produced faster than it can diffuse — conditions that do not pertain to a dwelling. When first produced in a room, whether by combustion or respiration, it is lighter than the surrounding air, and rises to the ceiling. There it gradually cools, and, falling, becomes equally diffused through the room; so that, as far as carbonic acid is concerned, it is just as healthy to sleep on the floor as on a high bed.

Normally, carbonic acid is present in pure air in about four parts in 10,000. In inhabited ventilated rooms it is usually slightly higher than this; but in very badly ventilated schoolrooms, theatres, and in private houses during evening entertainments, the proportion of carbonic acid may rise as high as 40, and even twice that many parts, in 10,000. If, however, the carbonic acid evolved is pure, as in establishments for bottling sparkling waters, charging soda fountains, breweries, etc., and in certain health resorts, as high as 150 parts in 10,000 can be breathed with impunity. So that it cannot be the carbonic acid alone in badly aired rooms that is injurious. Such being the case, why is all this importance as regards ventilation attached to carbonic acid, so that even as small a quantity as one or two parts in 10,000 becomes a matter of much moment?

It is because that, like men, carbonic acid is judged by the company it keeps. In this case, the very bad company is the poisonous, putrefying organic matter given off by the breath and skin. For these organic matters of varying composition science has not discovered any ready, convenient chemical tests whereby their quantity and quality can be accurately measured, while there are several tests, easy and of sufficient accuracy, for carbonic acid; and as this gas increases proportionately with the organic matter, its determination becomes a convenient method of estimating the latter. So that the importance of carbonic acid is simply as a measure of the impurity of the air.

As carbonic acid increases in a room, so oxygen inversely decreases; but as the amount of decrease is usually trifling, it need not be discussed.

Carbon Monoxide. — The second impurity, carbon monoxide, which is formed by the partial combustion of carbon, and which enters the room in imperfectly burned coal gas, and especially water gas, or through over-heated and leaky stoves, is very poisonous, and is especially dangerous, as it is odorless and causes no irritation to the air-passages when inhaled. It is thus unconsciously breathed, and the unfortunate person soon loses the desire for movement, and makes no effort to escape from the poisonous air.

Less than half of one per cent in the air has produced poisonous symptoms, and one per cent rapidly kills. When this gas burns, it burns with a blue flame, and is often seen in fireplaces and in stoves. People who blow out the gas, or who are suffocated from burning charcoal in open braziers, die from asphyxia by this gas.

Organic Matter. — Of the impurities of air, the most injurious is organic matter. A large proportion of carbonic acid, or carbon monoxide, may produce sudden death; but it is mainly to the presence of organic matter, either living bacteria or putrescent effete matter from the lungs and skin, that diseases of impure air are attributable. Wherever large numbers of people are massed together, these impurities are liable to exist in excess.

The danger of sewer gas is probably due to similar organic matters and bacteria. When drains are badly constructed, and in cesspools, the water becomes more or less stagnant; fermentation and putrefaction rapidly take place, gases are formed, rise to the surface of the fluid and burst, carrying up with the gas small bubbles of water, or additional sewer water comes splashing into the stagnant pool and throws a fine spray into the air, or the ascentional force of evaporation may carry up a fine mist. These minute particles of water contain micro-organisms, some of which are harmless indeed; but others are capable of setting up such diseases as sewer-gas poisoning, diarrhœa, and typhoid fever.

If these emanations are given off out of doors, they are less apt to cause trouble, as by the winds they are rapidly diluted and oxidized sufficiently to become harmless.

In doors the amount of sewer gas which enters our rooms is comparatively small, so that the poisonous effects are apt to be insidious, and the cause overlooked. Long continued breathing of this air may produce a general lowering condition of health and make the body less capable of resistance to concurrent diseases. The vitality becomes depressed; there is a constant lassitude, with disinclination to work, and usually lessened appetite, prostration, headache, and sometimes an obscure low fever, or sore throat, or diarrhœa. If the typhoid bacillus is present, then the victim may be taken down with this scourge.

People who live in crowded dwellings, or spend a great portion of their time in offices, schools, and factories, are more subject to chronic and debilitating maladies than those who live an out-door life, and they offer less resistance to acute diseases.

There is no doubt of the great mortality from consumption in persons living in badly ventilated rooms. A few years ago the proportion of deaths among the soldiers of European armies from this cause was very high; but now, owing to better ventilation, the other conditions remaining the same, the percentage has greatly fallen. In one regi-

ment in England when the barracks were not ventilated, the death-rate for lung diseases was twelve and a half per 1,000, but after efficient ventilation had been introduced it fell to one and a half per 1,000.

Parkes gives a similar example from two hospitals in Vienna. In one, very badly ventilated, of 4,280 prisoners, 220, or 51.4 per 1,000, died of consumption — of these, 42 of galloping consumption. In the well ventilated hospital, of 3,037 prisoners, 24 only, or 7.9 per 1,000, died of the same disease. The conditions in the two hospitals, excepting ventilation, being alike, the badly ventilated one had six and a half times as many deaths, from this cause alone, as the better aired one.

Knowing as much as we do now of the bacillus tuberculosis, the existing cause of consumption, we can see how easily it is spread in confined quarters. Thousands now who are victims of this dread malady are ignorant of the fact that every time they spit on the street, or on the floor, or expectorate into their handkerchief, they are letting loose hundreds of thousands of living, virulent bacilli; and that, as soon as the matter containing them dries, they are stirred up by one's feet, or swept into the air by the broom; or, when the handkerchief is shaken out before a second using, the air becomes filled with these microscopic germs, ready to be inhaled and to quicken the disease in themselves, or start it fresh in some one near and dear to them. When people are already sick, the organic emanation thrown off from their bodies is greatly in excess of what takes place in health, and more fresh air is needed at those times to keep the air of a room pure. Many diseases are increased in severity, and convalescence delayed, by impure air.

TESTS FOR IMPURITIES.

Of the tests for impurities, there are but three that are sufficiently simple and easy for the average person to apply. They are:

1. *Examination by Smell.* — The organic matters given off by the skin and breath, if allowed to remain in a room for

a short time, have a characteristic odor. Persons having a good sense of smell, and coming directly into an apartment from out of doors, can readily detect this peculiar odor, and can soon learn to judge with comparative accuracy the amount of vitiation of the air; and it is possible to develop this faculty to an extreme acuteness. The air of dwellings is, as a rule, less pure than that of the outside air, so that a certain degree of vitiation is taken as a standard of impurity. Remembering that the amount of carbonic acid in pure air is four parts in 10,000, an additional quantity of two parts is allowed in the air of rooms. If the amount of carbonic acid is increased beyond this limit, the air is considered vitiated. This addition of two parts, *i. e.*, six parts in 10,000, is the standard impurity; and, as putrescent, foetid organic matters increase regularly with the carbonic acid, we can construct a table of vitiation in terms of carbonic acid. The table is this: If this gas is in an excess of two parts only of pure air, the rooms smell fresh; if it is increased to four parts, the room has a slight musty smell; if to six parts, it has a very close, oppressive, offensive odor; beyond a further addition of one part, it becomes so extremly close that the sense of smell can no longer differentiate the extent of vitiation.

To apply this test, a person should have been in the open air for at least fifteen minutes, and must then enter the room as directly as possible, for this delicate sense of smell is rapidly lost, and it takes some time in the fresh air to regain it. If the room smells fresh on entering, it contains no more than six parts of carbonic acid in 10,000 (the standard of impurity), and is thus sufficiently pure; but if it smells musty or close, this limit is exceeded, and it requires ventilation.

2. *Tests for Carbonic Acid.* — The simplest, that proposed by Lange, is to take a bottle of 350 c. c. (12 oz.), the bottle being perfectly clean, and fill it with water to the brim to force out the air in it; then to empty the bottle in the room to be tested, and dry it. The bottle then is full of the air you wish to examine. Then put 15 c. c. (one half oz.) of

clear, fresh lime-water in the bottle, insert the cork, and shake vigorously for a few minutes. If the air contains seven parts per 1,000 of carbonic acid, a turbidity of the fluid will occur. This opacity can be more easily detected by gumming a piece of white paper marked with a cross in lead pencil to the side of the bottle; when the fluid becomes turbid, the cross will become dimmed or invisible when looked at through the water. If no turbidity occurs, the air is sufficiently pure. The exact extent of vitiation can be determined by using different sized bottles, but this one size is sufficient for ordinary testing.

3. *Wolpert's Air Tester.* — The principle of this apparatus is the same as the preceding, *i. e.*, it depends on the property of carbonic acid turning lime-water turbid. It is more convenient than the former, as one bottle is used to determine all grades of vitiation.

The apparatus is simple, easy to use, and cheap. It consists of a simple rubber bulb (A); a glass outlet-tube (B), with a constriction near its extremity (E). A glass test-tube (C) has a horizontal mark near the bottom, indicating the point to which it must be filled with perfectly clear lime-water. The bottom of the tube is whitened, and has a black mark stamped upon it (D). In order to use the instrument, the lime-water (saturated solution) should be poured into the test-tube till it reaches the horizontal mark. Press down the bulb with the thumb, so as to expel the air within it as completely as possible, and allow it to fill with air of the apartment; insert the small tube into the lime-water nearly to the bottom, and again expel the air with moderate rapidity, so that the bubbles may rise nearly to the top of the tube, but do not overflow, taking care to continue the pressure of the thumb till the small tube is removed from the lime-water. Repeat this process until the mark upon the bottom of the test-tube is obscured by the opacity produced by the

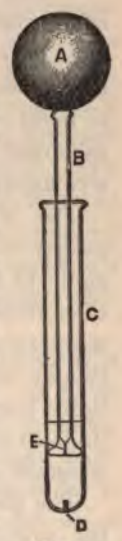


FIG. 1.

reaction of the carbonic acid upon the lime-water, the observer looking downwards through the lime-water from the top of the test-tube.

With very foul air, it is necessary to examine the mark after filling and discharging the bulb a few times only; with good air, it must be filled twenty-five times and upwards. A table accompanies the apparatus, so that, without calculation, the result can be directly read.

VENTILATION.

Money is the foundation of perfect ventilation. If expense is no object, it is easy to ventilate a house; but in dwellings with small rooms it is impossible at the same time to have good ventilation, sufficient warmth in winter, and cheapness. One of the three must suffer, and it is usually ventilation.

To the people who live in houses where no special forms of ventilating apparatus exist, and who are unable to procure expensive appliances, this paper is directed, its object being to explain the more important principles of ventilation, and to point out the simplest and best ways of keeping the air of inhabited rooms pure at a moderate cost and without expensive apparatus.

The aims of ventilation are, — to prevent air which is puffed out of one person's lungs from being breathed over again by the same or another person; to remove the products of combustion; and to maintain an equable and comfortable temperature, — and all this without creating draughts. With two or more persons in the room, especially in winter with lights burning, this is almost impossible. The best we can do is so to dilute the impurities that they will not exceed the standard of vitiation.

The purity of air in a room depends on several factors, — the source of the air, the amount of cubic space for each individual, the natural movement of air, the size and the position of the inlets for fresh and the outlets for foul air, the methods of heating and lighting, and the humidity.

The Source of Air. — The primary condition for ventilation is, that the incoming air shall be pure: it must be pure external atmosphere. Air that is drawn from small closed courts, or from between back-to-back buildings, or that has blown over refuse, or that rises from a cellar, is unfit for continuous breathing. The sun rarely or never visits these spots, and the winds get no chance to sweep through them. Especially bad is the cellar air, as cellars are apt to be damp, moldy, and dark, and are frequently polluted by decaying vegetables and the ash-heap; and currents of air are constantly passing through them from the soil below, so that sewer air from defective drainage in the neighborhood may easily enter and be sucked through the house. This danger is particularly great if the house is heated by a furnace whose wooden air-box passes through the cellar.

Cubic Space. — The amount of space which should be given to each individual in a room is a matter of much importance. Many people believe that if a room is large, less fresh air is necessary. But no matter how large the room, the air in it must be used up in a few hours at most, and it then requires the same amount of pure air per hour for each individual as a small room. A large room is, however, preferable, because in it sufficient air for ventilation can be more easily introduced, broken up, and warmed, without creating draughts, than in a small one; and the larger the room the greater the surface of wall and number of windows, and, therefore, the greater the insensible ventilation.

Out of doors there passes over a man, when the wind is gently blowing, 196,000 cubic feet of air an hour. In order that that much should pass over the same individual in doors, the entire air of the room would have to be changed from two to six times a minute, which is practically impossible, as nobody would stand such a current. Such large amounts of air are not, however, necessary. Sanitarians are agreed that each adult individual requires at least 3,000 cubic feet of air every hour, and this must be supplied without perceptible draughts. A room 10 x 15 x 20 feet holds 3,000 cubic feet

of air. The air of such a room must be entirely changed once every hour in order that one individual shall have the required amount of fresh air. If three persons are in the room, it must be changed three times during the hour. Complete renovation of air cannot be effected much more frequently than this, because if we attempt it we meet with one of the greatest difficulties in ventilation, namely, draughts. If air is moving more than two and one half feet a second we are sensible of it, and call it a draught, so that one of the problems of ventilation is, to supply a proper amount of air in a room at a speed that shall not exceed two and one half feet a second. If the room is small, we frequently cannot do this.

Diffusion. — The gases in air are never at rest, but are moving about among themselves inversely as the square root of their density. They are not deterred in their movements even by brick wall or plaster, but pass fairly readily through these when there is much difference in temperature between the inside and outside of the building, and especially when there is a wind. Painting, papering, and damp walls, on the other hand, reduce very greatly their permeability. Through the chinks and crannies about doors and windows, and in floors and walls, the air rapidly diffuses. The occupants of many rooms depend almost entirely on these chance openings for their supply. Unless the room is a very large one, with several windows and doors, the supply introduced by these sources is inadequate as regards the gaseous constituents; and the organic matter and bacteria are scarcely at all removed, as they cannot pass through walls, and in the comparatively still air of the room they soon settle to the floor.

The Action of the Winds. — Where the direct action of the winds can be applied, they exert a tremendous power in changing the air of rooms. They act by perflation and aspiration. We make use of the perflating action when we open the windows and doors, and allow the air to blow freely through. The room is thus rapidly flushed out, and the air

is by this means renewed many times an hour. But while this agent has such great power for good, yet it is difficult to control, it being frequently too strong, especially so when the temperatures inside and out are widely different; and, again, there may be a total calm, — so that this force cannot solely be relied upon for inhabited rooms. The wind also acts by aspirating, *i. e.*, a current in passing through the air causes a partial vacuum along its sides, and thus sucks the neighboring air towards itself. This force is taken advantage of in chimneys, for when the winds blow over the mouth of a chimney it draws air out from the inside, and thus creating a partial vacuum in the tube, air is sucked up from below to supply its place. If the top of the chimney, however, be below the level of the surrounding buildings, the wind may then blow down the chimney, creating a back draught and making the chimney smoke.

FIG. 2. — Diagram illustrating down draughts.

Movements Produced by Unequal Weights of Air. — When air is heated it expands, and if it can escape a portion will do so, so that what remains will be lighter, bulk for bulk, than the colder air outside. As it is lighter than the surrounding atmosphere it rises through it, and the cold, heavier air rushes in from all sides until the weights outside and in are in equilibrium. It is this property of unequal weights of air that causes winds. This force is largely relied upon, especially in winter, to ventilate houses in this climate. Most of our homes are provided with chimneys and fireplaces. During cold weather, when people are in a room with lights burning, whether other artificial heat is provided or not, sufficient heat is generated to raise the temperature of the room above that of the outside air. It therefore expands, and ascends through the chimney, and the cold air, even though the room be closed, filters in through all sorts of

apertures to supply its place. It thus acts as a very valuable ventilator. The rapidity with which air passes up the chimney is dependent on a number of factors, — as, the height of the chimney, its shape, area, the material of which it is composed, whether it is straight or crooked, the difference in temperature inside and out, and on friction. All these factors must be taken into consideration in determining the rapidity of flow; but as the calculations are rather complicated, they will not be introduced here.

Inlets and Outlets. — No scheme for ventilation can be efficient that does not supply an abundance of fresh air in a scientific manner. The cheapest and most thorough way of accomplishing this object is to open wide the windows and doors, and this should be done whenever the temperature is favorable; when practicable, these make the best inlets and outlets. But in this climate the windows must be kept closed a great part of the time in order to keep warmth in the room. Other means, therefore, have to be employed to supply the necessary fresh air. In providing inlets a number of things have to be taken into consideration. The inlets must be so placed that the air cannot blow directly on the occupants of the room, and they must be of such size that sufficient incoming air is obtained without a high velocity; for, if the movement is greater than two or three feet per second, draughts are experienced; and besides, a slow current is more favorable for uniform diffusion than a rapid one. If it can be avoided, air should not enter through openings at the level of the floor, as dust readily falls into the openings and fouls the air; and if the incoming air is cooler than the temperature of the room it chills the feet. The place of admittance of cool air should be above the heads of the occupants, and means should be taken to diminish the current if too rapid, and the flow should be directed upwards, as there, meeting the warmer air of the ceiling, it mingles with it, becomes warmer, and gradually spreads through the room. The external openings of the inlets should give on a place where the air is uncontaminated. They should be short, and so arranged that

they admit of ready cleansing. They should be numerous and small rather than large and single, as they are thus less liable to cause draughts. The ends inside should flare to help check the momentum of the current and favor diffusion. Externally they should have filters to keep out the dust, and to prevent the wind's blowing in too strongly. Inside they should have valves, to close them if necessary during very cold weather or high winds. They must not be placed too near an outlet, as the air could easily pass from one to the other without diffusing.

Air finds its way, as before mentioned, through numerous unintentional and unnoticed inlets, as cracks and crannies, and even through the solid wall. The intentional inlets, however, are made either in the windows or in the side walls, ceilings, or floors.

Inlets through a Window. — When the conditions are such that the window cannot be freely opened, it can be arranged in one of several ways to provide sufficient fresh air.

Hinckes-Bird's Method is the simplest. This consists of placing a movable block of wood (A) under the entire length of the lower window-sash (B), thus raising the top of the lower sash above the bottom of the upper. By this procedure considerable space between the two window-frames is left, through which the incoming air freely passes, and being impelled in an upward direction it causes no draught.

FIG. 3.

Tobin's Tube Modified. — In Tobin's tube the air from outside enters through a hole in the wall, and is conducted by an upright tube into the room. The opening of the tube is above the heads of the occupants, and the air escaping ascends towards the ceiling. It is an excellent method of admitting fresh air, but it is ugly and somewhat expensive. This method is not much used in this country, but, instead, a board is placed under the

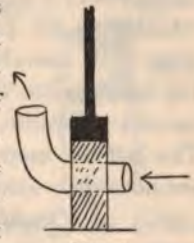


FIG. 4.

lower sash through which pass bent tubes; these admit the air in an upward direction. The principle is the same as in Tobin's tubes, but they have the advantage of simplicity and cheapness, and are just as good.

Auger Holes. — The above principle can be further simplified by boring a series of holes with an auger in a perpendicular direction through the bottom of the upper sash. These holes admit a considerable quantity of air in an upward direction, and can be closed at will with corks.

Canvas Windows. — A frame can be made the size of the upper sash, and covered with a light, loosely woven canvas. The upper sash then being lowered, this canvas frame is inserted in its place. There is a considerable exchange of air through this device, and the circulation is so slow that there is no draught. It is valuable in a sick-room, and is inexpensive.

Wire Screens. — A similar device can be made of fine wire netting instead of canvas. It allows air to pass more freely through than the canvas screen, and is very valuable when the weather is mild, and the wind is not too strong.

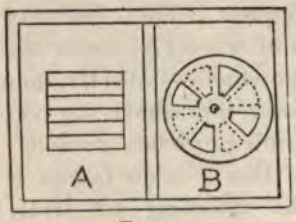


FIG. 5.

(A) *Louvres.* — One of the panes of glass can be lowered, and air admitted by this means in an upward direction.

(B) *Cooper's Ventilator* consists of a series of apertures in a window pane arranged in a circle, which can be partially or entirely closed by a glass disk movable on a pivot, with corresponding apertures. This method does not direct the current upwards, and it allows of a draught. The last two methods are rather conspicuous, and are not much used.

FIG. 6.

(C) *A Double Pane* may be used. The outer one is open at the bottom, and the inner one at the top. This is practically Hinckes-Bird's method on a small scale.

(D) *Hinged Pane.* — One of the panes of glass may be hinged at the bottom, and allowed to fall inwards a short distance, excessive motion being hindered with side checks. This is a good arrangement, especially if the sides are closed in. It is thus converted into a Sheringham valve.

Temporary Sheringham Valve. — In private houses during parties the rooms often become insufferably hot and close. These unpleasant features can to a great extent be avoided by having a temporary Sheringham valve constructed of wood and canvas, and inserted above the upper sash of the window, which is lowered for the purpose.

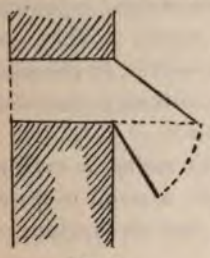


FIG. 7.

Sheringham Valve. — This is the most generally used form for inlet. It consists of an opening through the wall for the air to pass, the entrance being usually guarded by a strainer of some sort, to keep out dust. On the inside is a valved iron plate with closed sides and hinged at the bottom. An attachment is arranged to more or less completely close it. The entrance should be a little smaller than the exit, that the velocity of the current into the room may be diminished. It is usually placed near the ceiling.

Tobin's Tubes are usually placed in the corners of rooms. They take their air-supply directly from out of doors, as in the Sheringham valve. They have already been described under window ventilation.

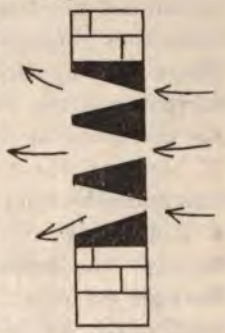


FIG. 8.

Ellison's Conical Bricks. — These are bricks with conical holes in them, the small openings being on the outside. By this arrangement the incoming air is widely distributed in every direction, and is thus prevented from causing as direct a draught as if the openings were of the same size all through. They, and in fact any openings which do not direct the current upwards,

are apt to cause a very disagreeable current to flow down the adjacent walls. The cold air seems to cling to the walls and descends like a douche.

This cold air shower is frequently encountered in churches or in rooms where the windows are high, by persons sitting near the wall beneath the open windows.

Hollow Ventilating Beams are sometimes, though rarely, made use of as inlets for fresh air. The hollow beam extends across the house from one external wall to the other, being open at both ends and having numerous openings into the room. They are divided, however, in the middle by a partition, so that they act at the same time both as inlets and outlets.

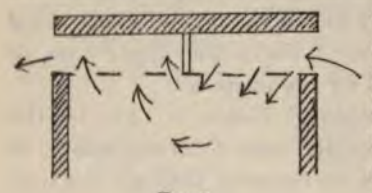


FIG. 9.

Mackinnel's Ventilator is founded on rather a curious property of air. It has been found, when a room is closed (that is, without visible inlets or outlets), and an opening is made in the roof and a tube inserted, that the ventilation of such a room is very poor. Sometimes the air descends in puffs, and sometimes the heated air of the room rises through the opening. There is no regularity about either current, and the two currents do not take place at the same time. If, however, the tube be divided longitudinally from top to bottom, a continuous current descends through one tube, and ascends through the other. Mackinnel's ventilator is an improved application of this principle. It consists of two tubes, one inside the other, both ends being open.

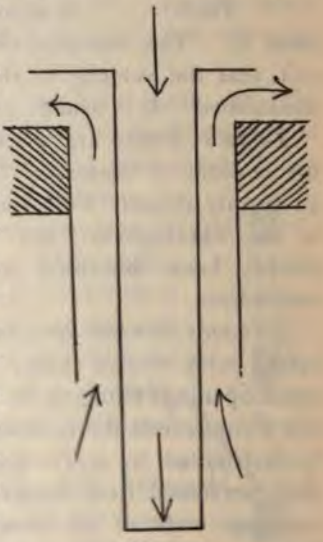


FIG. 10.

The inner tube is the longer, projecting above the outer at its upper end, and below it at its lower, where it is bent at right angles. The inner tube, as it is the longer, is the exit tube, and the outer becomes the inlet. The air coming in strikes against the flange of the longer inner tube, and is directed towards the ceiling and diffused.

Outlets. — The location of the outlet is very important, for on it depends the position of the inlets. If the air passing through the outlets can be heated, they may be placed anywhere. If not, they should be near the ceiling, or, if the room be domed, at the highest point of the dome. They should not be in the external walls if it can be avoided, as the air may become cooled in them, and then they will not draw well. They should be smooth and straight to reduce friction, and should be suitably covered to prevent rain's entering, and to help aspiration as well. If the air in the extraction shaft can be warmed, it is much more certain in its action. Under certain circumstances, which circumstances we will discuss a little later under the head of back draughts, all the above inlets may become outlets.

Extraction Tubes. — Frequently small tubes are run from the top of rooms, and especially from toilet rooms, for the purpose of ventilation. Usually they fail properly to accomplish this purpose, for the reason given under the head of the Mackinnel ventilator, and they are very liable to produce down draughts if there is an open fire-place in the house. So that the air from these rooms, instead of passing up the ventilator, is drawn through the living rooms to the chimney of the fire-place.

Open Fire-Places. — A chimney with an open fire under it is, under most circumstances, the best outlet. In ordinary dwelling houses, if proper inlets are provided, no other outlets are needed. It is very important, however, that the chimney should be of suitable size to change the air of the room sufficiently often, but at the same time the current of air passing through it should not be so strong as to cause a draught of air in the room towards it. Neither should it be

too large, as it is then wasteful of heat and is liable to cause a back draught and to smoke.

Arnott's Valve. — In rooms as usually constructed, with a fire-place and without other attempts at ventilation, it is found, especially when gas is burned in the room, that part of the heat and foul air goes up the chimney and part rises to the ceiling. In order to remove the products of combustion and the impure air, outlets may be made into the chimney flue near the ceiling. Arnott has constructed an opening and valve for this purpose, which permits the warm, bad air to pass into the flue, but prevents the reflux of smoke from the chimney into the room.

Outlets Warmed by Gas. — When we wish to use the chimney for purposes of ventilation, and an open fire is not available, we can heat the chimney or outlet shaft by burning a gas jet or a lamp in it. Either of these will warm the air sufficiently to cause an ascending current, producing an outlet.

Sometimes openings are made in the ceiling over a chandelier, which connect with an outlet tube, and which permit the escape of the products of combustion. This is an excellent method for the purpose, but is unfortunately rarely made use of, except in large public rooms, theatres, etc.

Back Draughts. — There are a number of causes of this annoying complaint, as, —

Too large a flue, the smoke going up one side and cold air down the other, the currents acting as they do in a Mackinnel ventilator.

Insufficient supply of air to the fire in a closed room. When the fire cannot draw air freely from the room, it sucks it down the chimney in fitful gusts to supply the deficiency, and fills the room with smoke. When this occurs, slightly opening the window will cure the difficulty.

Winds may blow down when the chimney is not capped, or when the top of the chimney is below the ridge of the house or lower than neighboring buildings (see page 241).

One heated chimney may draw air down unused chimneys in the same house if all the doors and windows are closed.

Rain may get into the shaft, and by evaporation cool the air in it. This air, becoming heavier than that in the room below, descends.

When the fire is first lighted, and before much heat is evolved and an up-draught established, the superincumbent heavy atmosphere in the shaft forces down the smoke.

A large hall and staircase running from top to bottom of a house and having an outlet on top may act as an enormous aspirating shaft drawing air to itself down the chimneys and from every room.

Methods of Heating. — Theoretically, we favor ventilation; practically, we dislike draughts. So that, while every one acknowledges that good ventilation is a desideratum, yet, as it frequently conflicts with our methods of heating, and is apt to produce cold-air currents, it is often neglected. No one, in order that he may breathe a pure atmosphere, is willing to sit in a draught; neither will anyone remain shivering in a cold room for the sake of fresh air.

During the winter, in this country at least, our rooms must be artificially heated, so that it will be wise to review the different systems of heating in order to determine what the most desirable method is that will ensure at the same time warmth and efficient ventilation.

Oil Stoves or Gas Stoves. — Rooms are sometimes heated by one of these means. Of all principles of heating it is the worst, as oxygen is used up, and, instead of being removed, the products of combustion are added to help vitiate the air.

Cast-Iron Stoves. — This is the cheapest method of producing heat, and the only one available to a great mass of the population. As the stove can easily be raised to a red heat, it becomes dangerous from the carbon monoxide which may be formed. It burns some of the organic matter in the air, producing a peculiar, disagreeable odor. Unless pans of water are on the stove, the air of such a room is apt to be too dry. It heats very quickly; but as it cools as rapidly, the temperature in the room is not apt to be uniform. If not over-heated, it does not appreciably vitiate the air of rooms.

It should remove its own products of combustion; to a slight extent it renovates the air of the room. It is much better than the gas or oil stoves.

Non-Ventilated Steam and Hot-Water Radiators. — In these systems the heating coils are placed in the room, but without any special means of supplying fresh air. These radiators are more convenient for many reasons than a stove. The heating surface never becomes so hot. They occupy less room. Except that the steam-coils burn the organic matter in the room, they do not vitiate the air. The air is, however, somewhat dryer than stove-heated air. The heat can be shut off and renewed more easily than in a stove. They are somewhat better than stoves, but are much more expensive.

Furnaces. — The air from a furnace is not so apt to be overheated as that from a stove. The pipes may, by the aid of several openings in one room, distribute the heat more evenly. They bring heated, presumably fresh, air to the room, instead of heating the more or less tainted atmosphere that is already present. As it is constantly introducing fresh air, the foul air must be as constantly escaping. It does not occupy space in a room. It is better than stoves, or unventilated steam or hot-water heating.

Ventilated Steam or Hot-Water Radiators. — When outside fresh air is passed over the radiators before it enters the room, it makes an admirable method of both heating a room and supplying fresh air. In large buildings steam or hot-water pipes are more easily distributed and occupy less space than furnace flues. For large buildings they are also cheaper.

Open Fire-Places. — This method differs from all the preceding systems in two important particulars. It warms by radiation instead of by convection. It affords an excellent outlet for the foul air of the room.

An open fire-place warms by first warming the walls, floor, ceiling, and furniture of the room, and they in turn warm the air. In this system the air of the room is usually cooler than the articles in it. It is the pleasantest form of heat, and the

glowing fire is cheerful to look at. It is the most healthful; for while it heats, it does not add any impurities to the air of the room. It is also a powerful ventilator. Open fire-places have, however, disadvantages. They are wasteful of fuel. They cause draughts. They do not heat the room uniformly. Frequently, in standing in front of a fire, one's face is too hot, while at the same time one's back is chilly.

The intensity of radiant heat is inversely as the square of the distance. Thus, if of two objects one is one foot and the other ten feet distant from the fire, they will be warmed respectively in the proportion of one and one hundredth.

Ventilating Fire-Places. — These are marked improvements on the ordinary fire-places. They have all the advantages of the latter, and in addition they prevent draughts of cold air by sending into the room air that is partially warmed. Fresh air is admitted to the back of the grate into a chamber which is warmed by a large heating surface, and, being carried up by a flue, discharges into the upper part of the room. There are a number of different kinds of ventilating fire-places and ventilating stoves made. The merits claimed for these improved fire-places are —

1. That they ventilate the room.

2. That they maintain an equable temperature in all parts of the room, and prevent draughts.

3. That the heat from radiation is thrown into the room better than from other grates.

4. That the fire-brick lining prevents the fire from going out, even when left untouched for a long time, and prevents the rapid changes of temperature which occur in rooms in cold weather from that cause.

5. That they economise fuel, partly by making use of the spare heat, which would otherwise pass up the chimney, and partly by ensuring by their construction a more complete combustion, and thereby diminishing smoke.

6. That they prevent smoky chimneys by the ample supply of warmed air to the room, and by the draughts created in the neck of the chimney.

Fire-Places and Ventilating Hot-Water Radiators. — In the houses where it can be applied, this double method of heating is the best way of combining warmth with ventilation. It is of course the most expensive. The hot-water system is preferred to furnace or steam-heating, for the reason that the heat is supplied at a much lower temperature than by either of the others. Air from a furnace is frequently delivered in a room at a temperature of 150° F., while it is almost impossible to heat the air passing over hot-water tubes to any such degree of heat.

If one bear in mind the various principles that have now been laid down, there should be no particular difficulty in arranging inlets and outlets, and of so using the method of heating at hand as to be able to obtain pure, fresh atmosphere, to distribute it properly, to breathe it warmed, and finally to remove the impure air.

PROTECTIVE INOCULATIONS IN INFECTIOUS DISEASES.*

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Deputy Surgeon-General, U. S. A.; Chairman of the Committee of the American Public Health Association.

No subject connected with the prevention of infectious diseases is of more importance, from a practical point of view, than that which was assigned to this committee at the Memphis meeting (1887) of the American Public Health Association; and the delay in submitting a report has not been due to a failure on the part of the committee to recognize the importance of the task assigned to it, but partly to the pressure of other engagements and the magnitude of the subject, and partly to the fact that experimental evidence relating to the subject has been constantly accumulating during the past five years, and the fundamental question concerning the explanation of acquired immunity has not been answered in a satisfactory manner until very recently.

Before proceeding to give an account of the results of protective inoculations in the various infectious diseases in which these have been practiced, we must consider at some length this question of the rationale of acquired immunity.

It has long been known that, in a considerable number of infectious diseases, a single attack, however mild, affords protection against subsequent attacks of the same disease; that in some cases this protection appears to be permanent, lasting during the life of the individual, that in others it is

* Preliminary report of the Committee of the American Public Health Association.

more or less temporary, as shown by the occurrence of a subsequent attack.

The protection afforded by a single attack not only differs in different diseases, but in the same disease varies greatly in different individuals. Thus certain individuals have been known to suffer several attacks of small-pox or of scarlet fever, although, as a rule, a single attack is protective. Exceptional susceptibility or insusceptibility may be not only an individual but a family characteristic, or it may belong to a particular race. A remarkable example of race immunity is that of Algerian sheep against anthrax, a disease which is very fatal to other sheep. Individual susceptibility also depends to a considerable extent upon the age of the individual. Young animals are more susceptible to infection than older ones. This is illustrated in the so called "children's diseases" of man, and in the diminished susceptibility to tubercular consumption after forty years of age. It is also well established by experiments upon the lower animals, the young being susceptible to infection by "attenuated cultures" of pathogenic bacteria which older animals of the same species are able to resist.

In those diseases in which second attacks are not infrequent, as, for example, in pneumonia, in influenza, or in Asiatic cholera, it is difficult to judge from clinical experience whether a first attack exerts any protective influence. But from experiments upon the lower animals we are led to believe that a certain degree of immunity, lasting for a longer or shorter time, is afforded by an attack of pneumonia or of cholera, and probably of all infectious diseases due to bacterial parasites. In the malarial fevers, which are due to a parasite of a different class, one attack affords no protection, but rather predisposes to a subsequent attack.

The experimental evidence relating to protective inoculations in infectious diseases dates from the discovery by Jenner (1768) of the protection afforded against small-pox by vaccination with lymph taken from the vesicles of cow-pox.

In the present report we shall omit any further reference to

vaccination, hoping that some other member of the committee may hereafter give such a detailed account of this particular application of protective inoculations as the practical importance of the subject demands.

To Pasteur must be accorded the credit of having first shown by the experimental method that animals may be made immune against other infectious diseases than the one mentioned by inoculations with an "attenuated virus." Commencing with his experiments upon chicken cholera, in 1880, we shall briefly trace the development of our knowledge up to the present date.

Having demonstrated that the disease of fowls known as chicken cholera is due to a specific microörganism, which he was able to cultivate in artificial media, Pasteur discovered that his cultures became "attenuated" as to their pathogenic power, when they had been kept for some time in the laboratory, and that fowls inoculated with these attenuated cultures suffered a comparatively mild and non-fatal attack of the disease, and were subsequently immune against the pathogenic action of the most virulent cultures, or against contracting the disease by contact with other fowls suffering from it.

Pasteur at once comprehended the importance of this discovery, and inferred that what was true of one infectious germ disease was likely to be true of others. Subsequent researches by this *savant* and by other bacteriologists, have justified this anticipation; and the experimental demonstration has been made in a considerable number of similar diseases.

Pasteur first obtained an attenuated virus for his protective inoculations against chicken cholera by keeping his cultures for a considerable time freely exposed to the air, and ascribed the attenuation to the action of atmospheric oxygen. He found that when cultures were made from the blood of fowls which died from a chronic form of the disease, they possessed an exceptional virulence, which was not lost when the cultures were renewed at short intervals, but that by keeping these cultures for two months the virulence was greatly

diminished, and fowls usually recovered when inoculated with such cultures. When kept still longer, his cultures finally lost all pathogenic power. In subsequent experiments with the bacillus of anthrax, Pasteur found that the spores of this bacillus retain their virulence for years, and that it was necessary to exclude them from cultures which were to serve for protective inoculations. When cultivated at a temperature of 42° to 43° C., this bacillus does not form spores; and Pasteur ascertained that cultures kept at this temperature for eight days no longer killed susceptible animals, and could be used in his protective inoculations.

Other methods of attenuating the virulence of pathogenic bacteria have since been discovered. Thus, Toussaint has shown that exposure for a short time to a temperature a little below that which destroys the vitality of the pathogenic microörganism modifies the virulence of a culture so that it may serve for protective inoculations. In the case of bacillus anthracis, Chauveau has shown that a temperature of 50° C., maintained for eighteen minutes, answers the purpose.

Attenuation of virulence may also be effected by exposure to certain antiseptic agents. This was first ascertained by the writer in experiments made in 1881, the object of which was to determine the comparative value of various disinfecting agents. Incidentally the fact was brought out that agents which do not completely destroy the vitality of a pathogenic microörganism may cause an attenuation of its pathogenic virulence. In the experiments referred to, the blood of a rabbit recently dead from a form of septicæmia induced by the subcutaneous injection of my own saliva, and due to the presence of a micrococcus (micrococcus pneumoniæ crouposæ), was subjected to the action of various chemical agents, and subsequently injected into a rabbit to test the destruction of virulence. In the published report of these experiments the following statement is made:

"The most important source of error, however, and one which must be kept in view in future experiments, is the fact that a protective influence has been shown to result from the

injection of virus, the virulence of which has been modified, without being entirely destroyed, by the agent used as a disinfectant."

"Sodium hyposulphite and alcohol were the chemical reagents which produced the result noted in these experiments; but it seems probable that a variety of antiseptic substances will be found to be equally effective when used in the proper proportion. Subsequent experiments have shown that neither of these agents is capable of destroying the vitality of the septic micrococcus in the proportion used (one per cent of sodium hyposulphite, or one part of ninety-five per cent alcohol to three parts of virus), and that both have a restraining influence upon the development of this organism in culture fluids."

Similar results have since been reported by European bacteriologists. Thus Chamberlain and Roux (1883) ascertained that the anthrax bacillus could be attenuated by adding to cultures certain antiseptic agents — carbolic acid, one to 800; bicromate of potash, one to 100.

Another method of attenuating the virus of a pathogenic microörganism is that recently (1892) discovered by Brieger, Kitasato, and Wassermann. This consists in the cultivation of pathogenic bacteria in a bouillon made from the thymus gland of a calf. It was found that the tetanus bacillus cultivated in this bouillon did not form spores, and had comparatively little virulence. Mice or rabbits inoculated with it in small doses — 0.001 to 0.2 cubic centimetre for a mouse — proved to be subsequently immune. And the blood serum of an immune rabbit injected into the peritoneal cavity of a mouse — 0.1 to 0.5 cubic centimetre — was found to give it immunity from the pathogenic action of a virulent culture of the tetanus bacillus. Similar results were obtained with several other pathogenic bacteria cultivated in the thymus bouillon — spirillum of cholera, bacillus of diphtheria, typhoid bacillus.

It has also been shown, by the Japanese investigators Ogata and Jashuara, that the anthrax bacillus, when culti-

vated in the blood of an immune animal (rat, dog, or frog), becomes attenuated as to its pathogenic power, and that such cultures injected into a susceptible animal give rise to a mild attack followed by immunity. Moreover, the injection of a small amount — one drop — of blood from a frog or a dog into a mouse, made before or after inoculating it with a virulent culture of the anthrax bacillus, was found to protect the animal from a fatal attack, and, after its recovery from the mild attack resulting from the injection, it proved to be immune. The protective influence was exercised when the blood was injected as long as seventy-two hours before the inoculation, or five hours after, and it was not lost when the blood was kept for weeks in a cool place. But subjecting it to a temperature of 45° C., for an hour, completely destroyed its power to protect inoculated mice from a fatal attack of anthrax.

Attenuation of virulence may also be effected by cultivating the anthrax bacillus in the body of a non-susceptible animal, like the frog (Lubarsch, Petruschky); or in the blood of the rat (Behring); by exposure to sunlight (Arloing); and by compressed air (Chauveau).

It is a matter of common laboratory experience that many pathogenic bacteria become more or less attenuated when cultivated for a considerable time in artificial media, even when the cultures are renewed at short intervals. This is true of the micrococcus of pneumonia, of streptococcus pyogenes, of the bacillus of diphtheria, of the spirillum of cholera, and to some extent from the tubercle bacillus. Indeed, as a general rule, pathogenic bacteria exhibit greater virulence when cultivated in favorable media and when recently obtained from the body of a susceptible animal; and, on the other hand, pathogenic virulence is diminished by cultivation under unfavorable conditions. Probably similar circumstances produce those differences in the type of epidemic diseases, as to malignancy or comparative mildness, which have been frequently noted; external conditions unfavorable to the development of the specific infectious agent causing an attenu-

ation of virulence and the reverse. As pathogenic virulence depends, to a considerable extent at least, upon the formation of toxic substances during the active development of the pathogenic microörganism, we infer that diminished virulence is due to a diminished production of these toxic substances.

An important step was made in the progress of our knowledge in this field of research, when it was shown that animals may be made immune against certain infectious diseases by inoculating them with filtered cultures, containing the toxic substances just referred to, but free from the living bacteria to which they owe their origin. The first satisfactory experimental evidence of this important fact was obtained by Salmon and Smith in 1886. These bacteriologists succeeded in producing an immunity in pigeons against the pathogenic effects of the bacillus of hog cholera, which is very fatal to these birds, by inoculating them with sterilized cultures of the bacillus mentioned. Similar results were reported by Roux, in 1888, from the injection into susceptible animals of sterilized cultures of the anthrax bacillus, and also of the bacillus of symtomatic anthrax. More recently (1890) Behring and Kitasato have shown that animals may be made immune against the pathogenic action of the bacillus of tetanus or the bacillus of diphtheria, by the injection of filtered, germ-free cultures of these bacilli. Similar results have been obtained by G. and F. Klemperer (1891), in experiments upon rabbits, with filtered cultures of the micrococcus of croupous pneumonia.

In Pasteur's protective inoculations against hydrophobia it is probable that the immunity, which is developed after infection by the bite of a rabid animal, is due to the toxine (toxalbumin?) of this disease present in the emulsion of spinal cord which is used in these inoculations.

There is also some evidence to show that a certain degree of immunity against tuberculosis may be produced in guinea-pigs by injections of the toxic substances developed during the growth of the tubercle bacillus — Koch's tuberculin.

Evidently the facts stated have an important bearing upon

the rationale of acquired immunity, and they appear to support the explanation offered by the writer in a paper published in the "American Journal of the Medical Sciences" in 1881, namely, that immunity depends upon an acquired tolerance to the toxic products of pathogenic bacteria. In the paper referred to I say:

"The view that I am endeavoring to elucidate is that, during a non-fatal attack of one of the specific diseases, the cellular elements implicated, which do not succumb to the destructive influence of the poison, acquire a tolerance to this poison which is transmissible to their progeny, and which is the reason of the exemption which the individual enjoys from future attacks of the same disease."

In my chapter on "Bacteria in Infectious Diseases," in "Bacteria," published in the spring of 1884, but placed in the hands of the publishers in 1883, I say:

"It may be that the true explanation of the immunity afforded by a mild attack of an infectious germ disease is to be found in an acquired tolerance to the action of a chemical poison produced by the microörganism, and consequent ability to bring the resources of nature to bear to restrict invasion by the parasite." In the same chapter the resources of nature supposed to be brought to bear in restricting invasion by the parasite are referred to as follows:

"If we add a small quantity of a culture fluid containing the bacteria of putrefaction to the blood of an animal, withdrawn from the circulation into a proper receptacle and maintained in a culture-oven at blood heat, we will find that these bacteria multiply abundantly, and evidence of putrefactive decomposition will soon be perceived. But if we inject a like quantity of the culture fluid with its contained bacteria into the circulation of a living animal, not only does no increase and no putrefactive change occur, but the bacteria introduced quickly disappear, and at the end of an hour or two the most careful microscopical examination will not reveal the presence of a single bacterium. This difference we ascribe to the vital properties of the fluid as contained in

the vessels of a living animal, and it seems probable that the little masses of protoplasm known as white blood corpuscles are the essential histological elements of the blood, so far as any manifestation of vitality is concerned. *The writer has elsewhere* (1881) *suggested that the disappearance of the bacteria from the circulation, in the experiment referred to, may be effected by the white corpuscles* which, it is well known, pick up, after the manner of amœbæ any particles, organic or inorganic, which come in their way. And it requires no great stretch of credulity to believe *that they may, like an amœba, digest and assimilate the protoplasm of the captured bacterium, thus putting an end to the possibility of its doing any harm.*

"In the case of a pathogenic organism we may imagine that, when captured in this way, it may share a like fate if the captor is not paralyzed by some potent poison evolved by it, or overwhelmed by its superior vigor and rapid multiplication. In the latter event the active career of our conservative white corpuscle would be quickly terminated and its protoplasm would serve as food for the enemy. It is evident that in a contest of this kind the balance of power would depend upon circumstances relating to the *inherited* vital characteristics of the invading parasite and of the invaded leucocyte."

This explanation is now very commonly spoken of as the "Metschnikoff theory," although as a matter of fact it was clearly stated by the writer several years (1881) before Metschnikoff's first paper (1884) was published. Metschnikoff has, however, been the principal defender of this explanation of acquired immunity, and has advanced considerable experimental evidence in its favor. We cannot at present attempt to review the evidence for and against this theory, but may say, in brief, that in view of experimental evidence shortly to be referred to, we are not prepared to accept it as a sufficient explanation of acquired immunity. We believe, however, that "phagycytosis" constitutes one of the factors upon which immunity depends, and plays an important part in enabling immune animals to resist invasion by pathogenic bacteria.

But recent researches indicate that the principal factor in the production of acquired immunity is the presence in the blood of the immune animal of some substance capable of neutralizing the toxic products of the particular pathogenic microörganism against which immunity exists. Or, in certain cases, in the germicidal action of some substance present in the blood and tissue juices of the immune animal.

These "defensive proteids" in the bodies of immune animals are called *alexines* by Buchner and *phylaxines* by Hankin.

In the nomenclature proposed by Hankin a defensive proteid produced in the body of an animal which has an acquired immunity for a given infectious disease, and which acts by destroying the pathogenic bacteria to which the disease is due, is called a *mycophylaxin;* and a defensive proteid produced in the body of an animal which has an acquired immunity, which acts by neutralizing the toxic products of the pathogenic bacteria to which the disease is due, is called a *toxophylaxin*.

Our knowledge of these defensive proteids has been acquired during the past two or three years, and dates from the discovery by Nuttall (1888) that the recently drawn blood of certain animals possesses decided germicidal properties. Buchner has shown that this property belongs to the blood serum and not to its cellular elements. This germicidal power varies greatly for different species of bacteria, being more pronounced in the case of some pathogenic bacteria than for others, and absent in the case of some of the common saprophytes tested. The germicidal power of fresh blood serum is destroyed by a comparatively low temperature, and by keeping the serum for a considerable time, but it is not neutralized by freezing. Behring has shown that the blood of different animals varies considerably as to its germicidal power. Thus the blood of the rat and of the frog is especially fatal to the anthrax bacillus, and the natural immunity of these animals against anthrax is probably explained by this fact. The substance to which this germicidal action is due

appears to be destroyed in exercising its destructive action, for a given quantity of serum will only destroy a limited number of bacteria, and when these are present in excess they develop abundantly in the blood serum, which in the absence of the defensive proteid constitutes an excellent culture medium.

Hankin (1891) has isolated from the spleen and blood serum of rats a globulin, possessing germicidal properties, to which he ascribes the power of rats' blood to destroy anthrax bacilli. This globulin is insoluble in water or in alcohol, and does not dialyze. In this connection we may state that other animal fluids have been shown to possess some germicidal power. This has been shown to be true of aqueous humor, of lymph from the dorsal lymph sac of the frog, of the fluid of ascities, and even of milk and of urine.

Reference has already been made to the experiments of Ogata and Jashuara which show that the anthrax bacillus becomes attenuated as to its pathogenic virulence when cultivated in the blood of an immune animal such as the frog or the rat, and the similar results more recently by Brieger, Kitasato, and Wassermann, in cultivating pathogenic bacteria in a thymus bouillon. Now this attenuation appears to be due to a destruction of the toxic products of the pathogenic bacteria by antitoxines present in the culture liquids. That such destruction may occur in certain cases at least is proved by recent experiments made in Germany and Italy.

Behring and Kitasato in their experiments upon tetanus and diphtheria have shown that the blood of an immune animal when added to a virulent culture of one or the other of these bacilli, neutralizes the pathogenic power of such cultures, as shown by inoculation into susceptible animals. And, also, that cultures from which the bacilli have been removed by filtration and which kill susceptible animals in very small amounts, have their toxic potency destroyed by adding to them the blood of an immune animal, which is thus directly proved to contain an antitoxine, which comparative experiments show not to be present in the blood of non-

immune animals. But in the experiments of Behring and Kitasato referred to, it was found that five cubic centimetres of serum from the blood of an immune rabbit mixed with one cubic centimetre of a virulent filtrate of the tetanus bacillus, and allowed to stand for twenty-four hours completely neutralized its toxic power, as shown by inoculations in mice; 0.2 cubic centimetre of this mixture injected into a mouse was without effect, while 0.0001 cubic centimetre of the filtrate without such admixture was infallibly fatal to mice. The mice inoculated with this mixture remained immune for forty or fifty days, after which they gradually lost their immunity. The blood or serum from an immune rabbit, when preserved in a dark, cool place, retained its power of neutralizing the tetanus toxalbumin for about a week, after which time it gradually lost this power. Behring and Kitasato have also shown that the serum of a diphtheria-immune rabbit destroys the potent toxalbumin in diphtheria cultures. It does not, however, possess any germicidal power against the diphtheria bacillus.

The Italian investigators, Tizzoni and Cattani, have obtained similar results, and have isolated from the blood of immune animals an albuminous substance which they believe to be the tetanus antitoxine and which has been successfully used in the treatment of a number of cases of tetanus in man.

G. and F. Klemperer have recently (1891) published an important memoir in which they give an account of their researches relating to the question of immunity, etc., in animals subject to the form of septicæmia produced by the micrococcus pneumoniæ crouposæ. They were able to produce immunity in susceptible animals by introducing into their bodies filtered cultures of this micrococcus, and proved by experiment that this immunity had a duration of at least six months. They arrive at the conclusion that the immunity induced by injecting filtered cultures is not directly due to the toxic substances present in these cultures, but that they cause the production in the tissues of an antitoxine which has the power of neutralizing their pathogenic action. The toxic substance present in cultures of the "diplococcus of pneu-

monia" they call *pneumotoxine;* the substance produced in the body of an artificially immune animal, by which this pneumotoxine is destroyed if subsequently introduced, they call *anti-pneumotoxine.*

In the experiments heretofore referred to, the destruction of the virulence of cultures by adding to them the blood of an immune animal has been shown to be due to the presence of an antitoxine. But we have also experimental evidence that immunity may depend upon the destruction of the pathogenic microörganism in the blood of an immune animal. In guinea-pigs which have an acquired immunity against vibrio Metschnikovi the blood serum has been proved to possess decided germicidal power for this "vibrio," while it multiplies readily in the blood serum of non-immune guinea-pigs (Behring and Nissen).

The writer has recently (May, 1892) obtained experimental evidence that the blood of the vaccinated, and consequently immune, calves, contains something which neutralizes the specific virulence of vaccine virus, both bovine and humanized. Four drops of blood serum from a calf which had been vaccinated two weeks previously, mixed with one drop of liquid lymph recently collected in a capillary tube, after contact for one hour was used to vaccinate a calf; the same animal was also vaccinated with lymph preserved on three quills which was mixed with four drops of serum from the immune calf and left for one hour. The result of these vaccinations was entirely negative, while vaccinations upon the same calf made with virus from the same source, and mixed with the same amount of blood serum from a non-immune calf, gave a completely successful and typical result.

The importance of the experimental evidence above referred to in explaining the phenomena of natural and acquired immunity is apparent. The facts stated also suggest a rational explanation of recovery from an attack of an acute infectious disease. But the idea that during such an attack an antidote to the disease poison is developed in the tissues is yet so novel, and the experimental evidence in support of this view is of such recent date that it would be premature to

accept this explanation as applying to immunity in general. It seems difficult to believe that an individual who has passed through attacks of measles, mumps, whooping-cough, scarlet fever, small-pox, etc., has in his blood or tissues a store of the antitoxine of each of these diseases, formed during the attack and retained during the remainder of his life, or continuously produced so long as the immunity lasts. Moreover, in those diseases to which the experimental evidence above recorded relates — diphtheria, tetanus, pneumonia — as they occur in man, no lasting immunity has been shown to result from a single attack, and in this regard they do not come into the same class with the eruptive fevers and other diseases in which a single attack usually protects during the lifetime of the individual.

Still, notwithstanding the considerable number of the diseases in which we have as yet no experimental evidence as to the presence of a specific antitoxine in the blood and tissues of immune individuals, it must be admitted that so far as the experimental evidence goes it is in support of the view that acquired immunity depends chiefly upon the presence of defensive proteids in the bodies of immune animals. And, if this is true, the suggestion at once presents itself that we may be able to confer immunity upon susceptible individuals by introducing into their bodies the antitoxine of a specific disease obtained from the blood of other individuals who have an acquired immunity against this disease. That this is possible in the case of certain infectious diseases of the lower animals has already been proved and the experimental evidence has been referred to.

Whether preventive medicine will be able to apply similar methods for the purpose of establishing immunity against the specific infectious diseases of man can only be determined by carefully conducted experiments.

In the case of small-pox the method of Jenner has been so satisfactory in its results and is so simple in its application that we would scarcely expect to substitute for it a method depending upon the direct introduction of an antitoxine, obtained, for example, from the blood of immune calves,

even if experiment should show the possibility of establishing immunity in this way.

But in yellow fever and in scarlet fever such a method might possibly be practicable and useful if there were any way of obtaining an antitoxine from the blood of persons who have suffered an attack of the disease, in sufficient quantity to serve the purpose. Already experiments have been in the therapeutic use of antitoxines in tetanus, and in pneumonia, with a very promising degree of success, and from our present point of view the practical application of the recent discoveries relating to defensive proteids seems to be in this direction rather than in prophylaxis.

In Pasteur's protective inoculations against hydrophobia, in persons bitten by rabid animals, it seems probable that an antitoxine is introduced with the emulsion of spinal cord used in these inoculations, and that the protection afforded depends upon this fact. Or possibly upon the development of an antitoxine in the body of the inoculated individual as a result of the introduction of a considerable quantity of a specific toxalbumin, produced by the hypothetical hydrophobia germ in the nervous tissues of the infected rabbit from which the spinal cord was taken.

Whatever may be the rationale of the immunity resulting from such inoculations, the fact that they have a considerable prophylactic value appears to be well established.

This is shown by the following statistical tables:* one showing the results of inoculations made at the Pasteur Institute in Paris during five years, 1886 to 1890; the other, a classified statement showing the results in a single year, 1890:

Year.	No. treated.	Died.	Mortality.
1886	2,671	25 =	0.94 per cent.
1887	1,770	13 =	0.73 "
1888	1,622	9 =	0.55 "
1889	1,830	6 =	0.33 "
1890	1,540	5 =	0.32 "
Total	9,433	58	0.61 "

* From the Annales of the Pasteur Institute, vol. 5, pp. 345, 346.

In the following table, A includes all persons treated who had been bitten by an animal proved to be rabid; B, persons bitten by animals examined by veterinary surgeons, and pronounced rabid; C, persons bitten by animals suspected of being rabid. The figures relate to the year 1890:

	No. treated.	Died.	Mortality.
A . . .	416	0 =	0.00 per cent.
B . . .	909	4 =	0.44 "
C . . .	315	1 =	0.46 "

There has been much scepticism with reference to the value of Pasteur's hydrophobia inoculations notwithstanding the favorable symptoms published by the Pasteur Institute in Paris, and by similar institutions in other parts of the world. This has, however, to a considerable extent, given way before the experimental evidence. With reference to this we cannot do better than to quote from a recent report by Dujardin-Beaumetz. In this report the following statistical table is given relating to the number of rabid animals as compared with the number of deaths from hydrophobia in the Department of the Seine, during a period of ten years, 1881 to 1891:

Year.	Cases of hydrophobia in man.	Number of rabid animals.
1881	21	615
1882	9	276
1883	4	182
1884	3	301
1885	22	518
1886	3	604
1887	9	644
1888	19	863
1889	6	367
1890	1	203
1891	4	400

In commenting upon these statistics Dujardin-Beaumetz calls attention to the fact that the figures show three periods

of ascension (1881, 1885, and 1888), in the number of rabid animals, attended with corresponding increase in the number of deaths from rabies in 1881 and 1885, but not in the years 1886 and 1887, during which the relative number of deaths was considerably less. This is ascribed to the protective inoculations which were commenced in 1886.

If we compare statistics for five years prior to 1885 (1881 to 1885 inclusive), with the five years following (1886 to 1890 inclusive), we find that during the first period there were 57 deaths from hydrophobia in the Department of the Seine and the number of rabid animals reported was 1,882, while during the second period the total number of deaths was 38 and the number of rabid animals was 2,681. That is, during the first period the ratio was one death to 33 rabid animals, and during the second, one death to 70 rabid animals.

According to Dujardin-Beaumetz, the total number of individuals living in the Department of the Seine treated at the Pasteur Institute from January 1, 1887, to December 31, 1891, was 1,224. Of these, 12 died notwithstanding the treatment, giving a mortality of 0.89 per cent.

During the same period, according to the above table, there were 39 deaths from hydrophobia among the residents of the Department of the Seine. We infer, therefore, that (39–12) 27 persons died during this period who had not submitted themselves to the Pasteur treatment. The mortality among those not treated as compared with the number bitten is stated to have been 15.9 per cent in 1887 and 13.33 per cent in 1888.

We have for some time had satisfactory experimental evidence that susceptible animals may be made immune against certain pathogenic bacteria by inoculating them after the method of Pasteur, with "attenuated cultures." This has been shown, by the savant named, to be true of anthrax, of rouget, and of chicken cholera; and protective inoculations against these diseases have been practiced to a considerable extent in France and in other European countries in which

these diseases prevail to such a degree as to call for such a measure of prophylaxis. But it is still a question whether from a practical point of view this method is to be preferred to the isolation of infected animals and the destruction of the infectious material. Certainly the latter method would be preferable where but few cases of an infectious disease exist in a region where there are a large number of healthy animals to be protected from infection — in anthrax, for example. No one would think of immunizing all of the cattle in a State or a county because cases of anthrax had appeared on a particular farm.

In the interests of the individual farmer it may be that protective inoculations practiced among his herds which have been exposed to infection would result in securing him against considerable losses. But such inoculations should not take the place of the isolation of animals already infected and the destruction of infectious material. If we had, for example, a satisfactory method of protecting horses against glanders by inoculations with an attenuated virus, no one would be inclined to advocate this mode of prophylaxis as a substitute for isolation and disinfection. But, on the other hand, in sections where anthrax causes annually a heavy loss among the sheep and cattle, owing to the fact that the fields are already infected over extensive areas, as is the case in certain parts of Europe, the question of protective inoculations becomes an important one.

In the infectious diseases of man the same conditions would no doubt control our practice if we had a satisfactory method of protective inoculation for each of these diseases. In yellow fever, for example, those would be inoculated who were compelled to expose themselves in an infected area; in scarlet fever those children who were shut up in the same house with a case of the disease or who had in any way been exposed to infection.

In the case of Asiatic cholera it may be questioned whether protective inoculations should be practiced as a mode of prophylaxis even if it were fully demonstrated that immunity, of

a certain duration, could be effected in this way. Permanent immunity we could not expect to produce, inasmuch as one attack does not protect from future attacks, but that temporary immunity may be induced by inoculations with cultures of the cholera spirillum appears probable from Shakespeare's account of the results of Ferran's inoculations in Spain during the last outbreak of cholera in Southern Europe, and from more recent experiments upon lower animals, and also upon man by Haffkine and by Klemperer.

Brieger, Kitasato, and Wassermann have recently reported their success in conferring immunity upon guinea-pigs against the pathogenic action of the cholera spirillum. They found that attenuated cultures suitable for use as "vaccines" could be obtained by cultivating the spirillum in bouillon made from the thymus gland of the calf, by which means they have also obtained attenuated cultures of the bacillus of diphtheria, the bacillus of typhoid fever, the bacillus of tetanus, and the streptococcus of erysipelas. Guinea-pigs inoculated with a culture in thymus bouillon which had been subjected to a temperature of 65° for fifteen minutes were found, after twenty-four hours, to be immune against virulent cultures in twice the amount which would otherwise have been fatal.

The virulence of cultures of the cholera spirillum is greatly modified by continuous cultivation in artificial media, and as shown by Haffkine, an attenuation of virulence may be quickly effected by cultivation in bouillon at a temperature of 39° C., with free access of oxygen. On the other hand, the virulence is greatly intensified by successive inoculations into the peritoneal cavity of guinea-pigs. Haffkine has shown that the attenuated cultures when injected subcutaneously in man or in guinea-pigs cause a local œdema and a slight febrile reaction, while the virulent cultures produce a more intense local reaction, and may even give rise to necrosis of the tissues about the point of inoculation. But this severe reaction does not occur if an inoculation with the attenuated virus has been made some days previously. And animals which have been inoculated subcutaneously, first with an

attenuated and then with a virulent culture do not subsequently succumb to intra-peritoneal injections of virulent cultures. Haffkine considers it probable that similar subcutaneous inoculations in man would give him a temporary immunity at least, and they would be of prophylactic value during the presence of an epidemic. Ferran had previously demonstrated by his extended inoculations that the introduction of the cholera spirillum into the subcutaneous connective tissue of man is a harmless procedure. This fact is verified by Haffkine's more recent experiments, which also show that a tolerance is thus established in man, as in the lower animals, against the local effects of subsequent inoculations with more virulent cultures.

Whether this method will be found to have any great practical value can only be determined by more extended experiments. But in view of the fact that other measures of prophylaxis, well known to sanitarians, are sufficient for the prevention of cholera epidemics, and that nurses and others who necessarily come in contact with cholera patients are not likely to contract the disease if they use proper precautions with reference to their food and drink, the disinfection of their hands, etc., we doubt whether protective inoculations will ever come into general use as a measure of prophylaxis against this disease. Certainly they cannot take the place of those sanitary measures which have been proved to be sufficient for the prevention of epidemics, namely, exclusion by a proper inspection service at ports of entry ("quarantine"), isolation of the sick, disinfection of excreta, general sanitary police of exposed towns and cities, boiling the water used for drinking purposes, etc. Still, under certain circumstances protective inoculations may have considerable practicable importance, and the experiments now being made have evidently great scientific interest in connection with the question of acquired immunity. Klemperer, of Berlin, has recently reported very interesting results in this connection. By inoculating man with sterilized cultures of the cholera spirillum, he was able to establish a considerable degree of immunity,

as shown by the fact that the blood of such individuals when injected into guinea-pigs protected them from the lethal effects of virulent cultures of the cholera spirillum. The cultures used in his experiments were sterilized by exposure for two hours to a temperature of 70° C., and eight successive subcutaneous injections were made. At the end of twelve days the blood serum of an individual subjected to this treatment was found to protect guinea-pigs when injected into these animals in the amount of one quarter of a cubic centimetre. Klemperer has also ventured to inject non-sterilized cultures under the skin of man, and has obtained evidence that such inoculations give rise to immunity, as shown by the protective influence exercised by the blood serum of inoculated individuals when introduced into the bodies of guinea-pigs. These inoculations with non-sterilized virulent cultures (0.35 c. c.) gave rise to a severe local reaction and to some fever, but proved not to be dangerous.

In view of the experimental results above referred to, it has occurred to the writer that possibly the protective inoculations against yellow fever, practiced some years since at Vera Cruz under the direction of Prof. Carmona y Valle, of the city of Mexico, may have had a rational basis not suspected at the time they were made.

Dr. Carmona gives the following account of his method of inoculation:

"The method of performing the inoculation is very simple. In the first place, the urine of the sick is collected, taking care not to take that of patients suffering from any visceral affection, still less from gonorrhœa or syphilis. It is well to employ the urine secreted when the disease is well established, because it contains a greater quantity of zoöspores. This urine is placed in large shallow plates, and abandoned to spontaneous evaporation, having care that the evaporation is complete, and that no trace of humidity remains. If the layer of residue is very thick it is well to spread it out so that it may be penetrated throughout by the oxygen of the air. By following this advice you will surely avoid the inoculation

of the microbes of putrefaction. When the residue is well dried it may be used for the inoculation. I usually place one or two centigrammes of the dry residue in a gramme of distilled water. I triturate it in such a manner that the mixture is as perfect as possible, and charging a Pravaz syringe, I make a subcutaneous injection in the right arm. The results are various, but no serious accident has ever occurred.

"I was first inoculated September 29, 1881. I felt a lively pain at the moment of the injection and some minutes after, but it disappeared promptly to give place to slight tumefaction, without redness of the skin, which interfered somewhat with the movement of the arm. The fourth day all had disappeared, and I really had no febrile movement, since the thermometer did not go more than a few tenths above 37°. The urine became scanty, and took a slightly reddish color. The malaise was insignificant, and I continued my ordinary occupations.

"I count, to-day, nearly two hundred persons inoculated, and among them several experienced, some hours after the inoculation, a febrile movement, which sometimes caused the thermometer to mount to 38.5°. The duration of this febrile movement did not exceed twenty-four hours. The local accidents have been most varied. There was almost always tumefaction at the point of inoculation, but the extent and size of this tumefaction varied greatly. In many cases there was redness of the skin. These local phenomena lasted four or five days, but in general those inoculated continued about their ordinary affairs. Once only I have seen developed a phlegmon which terminated by suppuration."

Dr. Carmona says in the above quoted account of his method, "It is well to employ the urine secreted when the disease is well established, because it contains a greater number of zoöspores." The writer has elsewhere given his reasons for doubting whether Dr. Carmona's so called "zoöspores" were, as for a time he supposed, the specific infectious agent in the disease under investigation. Without doubt a variety of microörganisms would be present in urine

which was permitted to evaporate spontaneously in a large shallow plate. But there is no satisfactory evidence that the urine of yellow fever patients at the moment of its escape from the bladder contains any microörganism other than those which are constantly found upon the surface of the mucous membrane at the meatus urinarius.

It is not improbable, however, that the highly albuminous urine of yellow fever patients may contain specific toxic products which have escaped from the blood, and which in the body of the infected individual give rise to the morbid phenomena characterizing the disease. If so, Dr. Carmona's dessicated urine may have contained the specific toxalbumin (?) of yellow fever in sufficient quantity to have produced a certain degree of immunity in the individuals inoculated by him. Certainly this is a possibility worthy of further consideration, and one that is not at all improbable in view of the facts heretofore mentioned relating to acquired immunity in other infectious diseases as a result of inoculations with filtered cultures containing the toxic products of pathogenic bacteria.

In the absence of any precise knowledge of the specific infectious agent in yellow fever two possible methods of establishing immunity by protective inoculations present themselves. One, following the indication afforded by Professor Carmona's experiments, in which the object is to introduce a sufficient quantity of the specific yellow fever toxalbumin, assuming that such a substance exists in the blood of yellow fever patients during the progress of the disease. The other, to introduce into the circulation of susceptible individuals the yellow fever antitoxine, which, reasoning from analogy, we suppose to be present in the blood of immune individuals.

In experiments to determine the possibility of establishing immunity by the first method we would suggest that the urine had better be quickly evaporated *in vacuo*. Possibly also the toxic substance assumed to be present may be obtained in a more concentrated form, free from urinary salts and other

impurities, by precipitation with alcohol, by dialysis, or by some other method known to physiological chemists. Again, it may be that the yellow fever toxalbumin could be obtained by chemical methods from the blood of those recently dead. Evidently here is a broad field for experiment, but it is one in which special training will be required on the part of the investigator, and great conservatism in drawing conclusions as to results attained.

The second method suggested would be tested by injecting blood serum from an immune individual into the circulation (or subcutaneously ?) of one susceptible to the disease, who must necessarily be exposed in an infected locality. Evidently numerous carefully conducted experiments would be required to establish the value of either of the methods suggested.

Another line of experiments which has suggested itself to the writer would be to treat cases of the disease by the injection into a vein, of blood serum from an immune individual. Possibly the, at present hypothetical, antitoxine might be present in such serum in sufficient amount to exercise a specific curative effect. This is one of the possibilities which can only be settled by the experimental method, but in the present state of science such experiments appear to the writer to be not only justifiable but extremely promising as to their results.

Yellow fever is a disease in which a satisfactory method of establishing immunity would be of great practical value, for susceptible individuals, and especially sailors and soldiers, are often necessarily sent to infected localities. The annual loss of life among those who venture to visit the endemic foci of the disease for business or pleasure is also very considerable. Moreover this disease is one in which there is every reason to believe that an artificial immunity might be established if we could succeed in isolating and cultivating the specific infectious agent, for it is well established that an attack of the disease affords a very lasting immunity, which, however, is not absolute, against subsequent attacks.

The committee on "Protective Inoculations in Infectious Diseases" proposes to give in subsequent reports a detailed account of the results of protective inoculations as practiced in various infectious diseases of man and of the lower animals, and also to report from time to time such additions to our knowledge as have a bearing upon the explanation of acquired immunity, and upon methods of conferring such immunity without danger to the individual or to the public health.

THE ADVANTAGES OF ABOVE GROUND COLLECTION OF HUMAN EXCRETA, WITH A SIMPLE AND INEXPENSIVE ARRANGEMENT FOR THE DESTRUCTION OF SAME BY DRY GARDEN MOLD.

In view of the constant presence of typhoid fever at all times, of cholera infantum, and the bowel affections of adults during the hot season, and the threatened coming of cholera, the following circular is of the greatest importance to the population of townships, villages, and cities, where the disposal of human excreta is by a "hole in the ground," privies and cesspools.

These are the very places where the above named diseases find their best soil for virulent and rapid growth and widespread distribution. They, with the garbage heaps, are the common routes for the impurities and poisons which find their way from decaying animal and vegetable matters into the soil and water of inhabited places and into the common air of inhabited houses and towns.

The only remedy from these constant and increasing dangers is to clean out, disinfect, and fill up with clean earth all "holes in the ground," and to dispose of their contents with the garbage, by shallow burial on plowed and cultivated lands. This is the natural way, and a "dumping ground" without such burial is an inevitable nuisance.

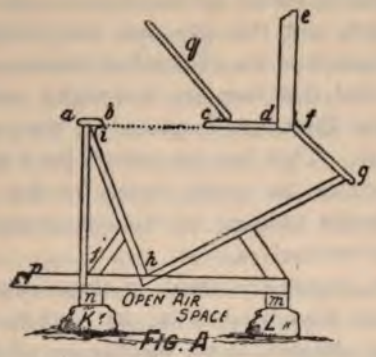

FIG. A

Section through out-door earth closet. a, b, c, d, seat, usual size; f, g, h, i, receptacle for excreta; h, under point little back of centre of hole, b, c; h, g, so inclined to give room between f and g, for removing earth and excreta; f, g, door swinging on hinges; f, opening for cleaning, airing, and sunning the box, g, h, i; i, zinc to direct urine into box; p, floor of house; e, wall of house. Box, i, h, g, rests upon sills, m and n, of house. Sills, m and n, should rest upon stones, k and l, and they on top of ground, leaving space for circulation of air. Box, i, h, g, to be made of plank and saturated with petroleum paint before use.

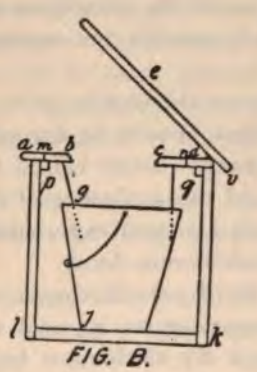

FIG. B.

Section through centre of house closet. a, b, c, d, seat, distance, a, d, 13 in.; a, b, 4½ in.; b, c, 10 in.; b, c, the seat rests on cleats, p and q, and can be removed, joints at m and n.

To b, c, is attached a truncated cone, g, h, of zinc, 4 in. long; diam., 12 in. at top, 8 in. at o; g, j, is zinc pail, 13 x 13 in., with bail n; cover, v, e, turns on hinge, d, and serves for back, when raised. The box to be saturated with boiled linseed oil. The earth box of the same size and oiled. The earth scoop of zinc, capacity, 1 pint. Use coarsely powdered charcoal with he earth, if possible.

The principles involved in the sanitary use of dry garden mold, peat, clay, and the like, are very simple, and their practical application to the disposal of human excreta is very easy too, provided that they are thoroughly understood, and that their natural limits are respected in their application to the intended use. This has not always been done, in the attempt to substitute the earth closet for the "hole-in-the-ground," by health officers, or by householders who have attempted it for themselves.

As has been repeatedly stated, in these columns, the majority of all who have tried to use dry earth for this purpose, have paid more attention to the mechanism of the closet than to the quality and condition of the earth. While some have trusted to the mechanism and omitted the constant oversight without which any machine will, in the long run, fail.

The principles involved are these:

1. Dried (best, sun-dried) and coarsely pulverized garden mold, peat, clay, (and other soils, in proportion to the amount of these which they contain,) prevent the odors of putrefaction, and secure the conversion of excreta into combinations harmless to animals, but exactly adapted to nourish vegetable life.

2. To do this most thoroughly, it is essential that soil of the character specified, should be *dry* and *in powder*. The apparent, and probably correct reason for this is the freest admission of air, and the avoidance of that "water-logged" condition, which, in common experience, is so favorable to putrefaction and mal-odorous decay.

3. When used for dry earth closet, no other fluids must be added than those accompanying each discharge under, and upon which, enough dry earth must be thrown just before, and just after use, to prevent any appearance of *wet*. Dampness is permissible, soaking wet not. *The dry earth closet is not adapted to the disinfection of chamber or kitchen slops*, and should never be used for that purpose. Assuming that the above conditions have been complied with, dry earth as specified, and in quantity at least a pint before, and after

use, the earth closet may be relied on for efficient work, under intelligent and regular supervision. Out of doors the freest ventilation consistent with dryness is desirable. This should be above, below, and all around the container.

Another essential is that the container be non-absorbent of either odors or fluids; still another, that it be of such form as to be easily and thoroughly emptied and cleaned; and, lastly, that the mechanism be of the simplest and least expensive construction consistent with efficiency.

All these requirements are reasonably met in the plans herewith submitted. Figure A represents a section of an outhouse, in which the ordinary construction is changed to that of an inexpensive earth closet, costing less than a single cleaning of the old and filthy vault. It is, as the engraving shows, open to the air on all sides, and its walls should be low enough to permit free ventilation between the seat and itself at the ends. Behind, it projects sufficiently to make the removal of its contents easy, but has a cover to keep out the rain. The whole interior of the box (well made of seasoned wood) must be saturated with petroleum paint, repeatedly, till the surface is glossy. Then, when thoroughly dry, it will resist all fluids and be easily cleaned as need be. For the dry earth, a box or barrel, with a pint zinc scoop for handling it, should be on the floor of the outhouse, handy and ready for use.

For household or sick-room use, No. 2 is all that is required, provided the following conditions are complied with:

1. That the fluid excreta be collected in an earthen vessel for other disposal, and not (except for young children) admitted to the closet.

2. That the earth be thoroughly dry, and in coarse powder. An admixture of coarsely powdered charcoal is a cheap, easy, and very efficient addition, for either in-door or outside use. *Use no odoriferous disinfectants in earth closets.*

3. That the closet be under constant supervision, and that the first evidence of foul odor be immediately investigated.

The conditions seem, at first sight, onerous, but, after all, they are no more so than those which should govern the care of water-closets and sinks. The household earth closet, conveniently placed in the woodshed or other place outside the house, but not out of doors, will, especially in winter, be found a healthy substitute for the usual outhouse, and do away with the inclement journey which is so common an excuse for the neglect, or postponement, of a necessary daily duty.

The winter use of the earth closet. — The earth to be used being dry does not freeze, so that it is as available and efficient as in summer, whether out or in doors.

The preparation of the dry earth. — A coal-ash sieve for sifting the earth before drying. The sifted material should be spread on a floor or rough platform, under shelter from rain, but open to air. As fast as dried, store in barrels, in a dry place.

A half dozen barrels will serve a large family from October to May. It is easy and better to provide twice as much.

The disposition of the contents of the earth closets, if cared for as above directed, is very easy and inoffensive. Those in No. 1 can be quickly shoveled into a wheelbarrow and thence on the garden, spading it under the surface soil near growing things. As to the winter accumulation, it will, of course, remain in the out-door closet till thawed out in the spring, when it is to be treated as above. Any accumulations in the house closets should be collected under cover *out of doors*, and treated as above in the spring. — *Charles N. Hewitt, M. D., Secretary Minnesota State Board of Health.*

TUBERCULOSIS IN ANIMALS.*

BY JAMES LAW, F. R. C. V. S., ITHACA, N. Y.

The subject of tuberculosis has in past times given rise to many fallacious speculations and rather blind precautionary measures. Prevailing, as it did, so widely among men and animals, it naturally engaged to a large extent the attention of physicians and of the public at large.

In the earliest ages there seemed to be a vague general dread of disease, — thus the Jewish law prohibited the people from eating carnivorous and omnivorous animals which were likely to derive disease from others directly through their food, the animal that died of itself, and that which showed clear evidence of disease when slaughtered. To the present day the Rabbi carefully inspects the internal organs, and if he detects any manifest disease he marks the carcase *traver*, which may be sold to the Gentiles, while the sound or *kosher* meat is alone disposed of to the faithful. He gives, however, special attention to the chest, the common seat of tuberculosis. He even goes to the length of inflating the lungs, and if at any point there is a breach, so that bubbles of air escape, the carcase is branded *traver*.

So among many primitive peoples the man who touched a dead body became ceremonially unclean, and in Ancient Greece the priests of Jupiter might not pollute themselves by even touching meat until it had been cooked.

In the middle ages tuberculosis was generally recognized as a communicable disease, being confounded with syphilis in

* Paper presented at the public winter meeting of the State Board of Agriculture at Peterborough, December 29, 1892, by Prof. James Law, of Cornell University, Ithaca, N. Y.

man; and in Germany and Italy laws were passed interdicting the use of the flesh of tuberculous animals under severe penalties.

Later, Lorin and Dupuy confounded the disease with glanders, mainly on account of the similarity of the rounded diseased masses in the two maladies.

Later and more scientific observation showed the lack of identity of these three diseases which so resembled each other in the slow and insidious nature of their progress, and in the naked eye appearances of their specific products, and physicians gradually came to accept the opinion that tuberculosis was a disease inherent in certain constitutions and families, and developed in such under any disturbing influence. The conviction of its transmissibility lingered, however, among the common people, and in the south of Europe, to which the consumptives flocked for relief under a more genial climate, the disease became so prevalent, even among the natives, that no one ventured to dispute its communication by contagion. Hence, before the crucial experiments of Villemin in 1865, which demonstrated the inoculability of tuberculosis, the furniture of any room in which a consumptive person had died, in any Italian city, was burned up, and the friends or estate of the deceased were drawn upon to pay the bill. Illogically enough, there was no such destructive disinfection enforced in case of a room in which a consumptive person had lived, provided he left it before death ensued. The householder was always pleased to admit another invalid and to give him the full benefit of the infection left by the previous occupant, who had gone off to occupy and contaminate another apartment somewhere else. These one-sided and inadequate precautions have resulted in leaving Italy the most consumption-ravaged country of Europe. Her balmy air drew the sufferers from every source, and the effect of the salubrious climate has been far more than counterbalanced by the concentration of the poison, which has passed from man to man, and from man to beast, until Perroncito declares that among the herds of the peninsula it has become a veritable plague.

The observation of the disease in animals served to keep alive the belief in contagion. Thus Dr. Rühling, of Gœttingen says in 1774, "the malady is transmitted to other animals previously sound through their licking each other and inhaling each other's breath while standing side by side in the stall, also by frequenting the same pastures." Again, in Krünitz's Encyclopœdia, published in Berlin (1787), it is alleged "that the malady is contagious, and conveyed from animal to animal by contact." Thus the belief in contagion persisted among veterinarians, as we see in the writings of Fromage, Hazard, Spinola, Lafosse, Dupont, Cruzel, and Zannger. It was only known in 1865, when Villemin published his successful inoculations of rabbits and guinea-pigs, that the attention of physicians was again drawn to the subject, and on the part of English and American physicians especially it was with a feeling of decided unbelief and opposition that they set about putting the Frenchman's conclusions to the test.

ESSENTIAL CAUSE. — BACILLUS TUBERCULOSIS.

But the stern logic of facts slowly convinced all candid observers of the reality of the contagion, and when, in 1882, Robert Koch demonstrated the existence of the tubercle bacillus, and showed that the disease could be produced with equal facility by inoculating with the material of a tubercle from an ox's lung, or with the isolated bacillus from a colony grown on a gelatine preparation, the last shade of opposition gave way, and the medical world came round to the opinion that consumption was infectious.

To-day there is the universal concurrence of intelligent men that tuberculosis is a germ disease which can no more appear in any animal or organ without the planting of the bacillus than can wheat grow up in a soil in which its seed has not been planted. Usually its development is slow, and it is often difficult or impossible to trace every case back to its true source; yet the incontrovertible fact that the one essential cause of the disease is the presence of the bacillus is a

sufficient answer to any claim of the development of the malady from unwholesome conditions of life in the absence of the germ.

The germ is a minute rod, so small that 2,500 of them placed end to end would barely extend an inch. They increase by growing out lengthwise and dividing in two, and by a continuation of this process they form clusters or colonies in the tissues where they are planted, cause inflammation in the part, and finally in many cases the death of the round nodular product, and its degeneration into a cheesy, yellowish white mass. The mere presence of a bacillus, however, is not sufficient evidence of tuberculosis, not even if that bacillus has been found in a cheesy mass. In glanders, which attacks all farm animals but cattle, there is a similar degenerated cheesy rounded mass, or nodule, containing a similar bacillus or rod a little shorter and thicker than the tubercle bacillus, but not sufficiently so to be distinctive, considering the fact that each multiplies by growing in length and dividing across. The distinction between the tubercle bacillus and others found in similar circumstances is based on the difficulty with which it absorbs coloring matter, and with which it may be again bleached from such colors. The other bacilli stain more quickly and deeply in pigment solutions, but they part with the stain with equal rapidity, and thus after prolonged staining and moderate bleaching such bacilli are rendered colorless and practically invisible under the microscope, while the bacillus tuberculosis stands out deeply stained.

The presence in a nodular swelling in the tissues, whether that nodule is soft and red, firm, white, and fibrous, or soft and cheesy, the presence in such of a rod-shaped body shorter than the breadth of a red blood globule, staining slowly in solutions of pigment, and retaining the color obstinately when subsequently placed in a bleaching solution, is substantial evidence of the existence of tuberculosis.

ACCESSORY CAUSES.

No one to-day presumes to question the claim of Koch that "We can with good reason say that the tubercle bacillus is not simply one cause of tuberculosis, but its sole cause, and that without tubercle bacilli you would have no tuberculosis." But it by no means follows that all previous investigations as to the supposed causes of tuberculosis are thereby rendered of no account. Far from it. The seed is a prime essential, without which there can be no crop, but you must have in addition a suitable soil and favorable surroundings in order that any seed may grow and prosper. Wheat will not grow on the bare rock, nor will it mature in the salty sand of the seashore. So with the bacillus tuberculosis; it must have a favorable soil and climate in order to luxuriant growth. I may name some of the accessory conditions.

1. — *Hereditary Predispositon.*

It has long been noticed that consumption runs in families, and hence it was looked upon as essentially a hereditary disease, and every precaution was taken to prevent the development of the disease in those who had received the fatal bequest. We now know that the disease itself is very rarely hereditary. From the bodies of thousands of tuberculous cows killed in the abattoirs of Europe, the number of tuberculous offspring taken may be counted on the fingers of the two hands. Sumner records five instances, and Johne and others three more. Landouzy and Martin produced tuberculosis in a guinea-pig by inoculating it with the juices of an apparently sound fœtus of a tuberculous woman. Krabasoff inoculated a pregnant guinea-pig and found the germs in the offspring.

Such meagre gleanings of congenital cases as compared with the notorious prevalence of tuberculosis in certain families suggests the conclusion that the proclivity to the affection in such cases is not an indication of inherited disease, but rather of a susceptibility to contract the disease. This conclusion is further strengthened by the facts that, even in milk calves the cases are very rare — under one per cent where the adult cattle

are six per cent — and that in such cases the disease in a large proportion of cases attacks the bowels, intimating that the infection has entered the system in the milk. Not a few of the obstinate and fatal bowel disorders of sucking children and calves are in reality tuberculosis of the bowels induced by the milk.

This family susceptibility is often so strong that it is no wonder that our fathers looked upon it as the sole or main cause of the disease. I shall quote but one case in cattle in point. In 1877 I recognized the existence of tuberculosis in the Jersey herd of Burden Bros., of Troy, N. Y. The worst were slaughtered, but some incipient cases in young animals were turned out in a pasture by themselves, where they passed the summer in apparently robust health, but they began to droop when returned to the barns in the fall. I again visited the herd, and picked out eleven diseased animals, and had them killed, when Mr. James Burden informed me that I had destroyed every representative of a certain family, not even a grade having been left. From that day on there was no more trouble with tuberculosis in that Jersey herd.

Is it possible to offer a stronger argument for the restriction of our breeding herds to families that have shown themselves to be specially insusceptible to this disease?

2. — *Close Buildings.*

Thirty years ago Dr. Macormac wrote a large book to prove that tuberculosis is the result of imperfect ventilation and of breathing the same air over and over. We now know that by itself, and in the absence of the germ, this could never have produced tuberculosis, but none the less the book is pregnant with truths of the greatest value to every householder and every stock owner. The case of the Burden Jerseys already referred to is one in point. Though the disease was already recognizable in the spring, the subjects showed an appearance of blooming health all through the summer pasturage, but when returned to the close barns they fell off so that very soon they had to be helped up in the stalls.

The contrast between the cattle of the prairies and plains and the cows pent up in our city dairies is no less striking. In 2,273,547 fat cattle inspected by the Bureau of Animal Industry only 492, or .02 per cent were found tuberculous. Out of 54,158 cows, 669 or 1.23 per cent were tuberculous. For every tuberculous ox from cattle raised in the open air there were sixty tuberculous cows kept in the barns of the cities and country. This, however, does not tell the whole truth. In shipping cattle a long distance from the plains to Omaha or Chicago, a selection is first made; the fat and the healthy are disposed of, while the unthrifty, which would not pay for carriage and would spoil the sale of the others if sent, are kept at home. On the other hand, the dairy cattle of our large Eastern cities, from New York to Baltimore, and of Chicago have been recently killed out in rooting out lung plague, and their places have been filled with fresh healthy cows from the country. A fairer estimate may be obtained from some of the cities of the Old World. Thus, in Copenhagen the proportion tuberculous in the cows slaughtered was 16 per cent (Bang), in Holland it rose in some localities to 19 per cent, and in some places in England to 26 per cent (Cope). In Delaware county, N. Y., I have examined hundreds of cattle without detecting a single case of tuberculosis, while in some suburban herds I have found as many as 50 per cent tuberculous. In one high-class herd 40 tuberculous have been killed during the past two years, and of the 20 remaining half are under grave suspicion. In another Devon herd I found 59 out of the 60 cattle manifestly tuberculous. All this goes to show that, in an open air life, or in the absence of the germ, tuberculosis may be entirely absent, whilst that in presence of the germ, the close crowding of animals in a poorly ventilated building contributes largely to its spread.

Mr. Even records that in Buenos Ayres the native stock suffer to the extent of half of 1 per cent, whilst newly imported stock to the extent of 10 or 15 per cent. Here the confinement and breathing of impure air on shipboard is fairly chargeable with the increased prevalence. This speaks in the

strongest terms for an open air life, and for cattle raising in a climate such as the Southern States and Pacific Coast, in which stock can be constantly out of doors.

In our Northern States, and especially for dairy cows, good shelter is essential, and here, accordingly, our attention must be given to secure perfect cleanliness and good ventilation, but, above all else, the exclusion of the germ. The rebreathed air lays the system open to the attack, but that attack will never come if the bacillus is absent. A number of years ago I found 50 per cent of the dairy herd of a large state institution in New York affected with tuberculosis, and among other things, I advised the disuse of a close, ill-ventilated brick barn. The cattle were destroyed, and the barn thoroughly disinfected, and though again filled with cattle, there has been no further trouble.

DARK STABLES.

Like rebreathed air, darkness predisposes strongly to the disease. Indeed, it acts to some extent in the same way. Like the colors of plants, the colored elements of the blood — the red blood globules — are developed under the action of light, and in darkness the red globules become deficient. But these red globules are the carriers of the oxygen from the lungs to all parts of the body, and if there are too few globules available, less oxygen reaches the different tissues, and they suffer exactly as they would if the air had already been breathed and robbed of its due proportion of oxygen.

INSUFFICIENT FOOD.

Whatever weakens the constitution diminishes its power of resistance to this as to most other germs, and poor and insufficient food holds a high place in thus predisposing to tuberculosis. At the same time the fattest animal is not, therefore, proof against tuberculosis. Hence scrofula has been the scourge of the poor, as tuberculosis has been of dairy herds. In the latter the demand for the nourishment of the calf, and the feeding adopted to stimulate the milk, together

with the urging of the udder by clean, careful milking, strain the digesting and assimilating powers to the utmost, and in the presence of the bacillus many fall under its sway.

INBREEDING.

Persistent close breeding is undoubtedly a common factor in developing that predisposition to tuberculosis, mainly, no doubt, by reason of its intensifying the already existing family character of susceptibility, just as it intensifies and fixes other family traits, good and bad. There is every reason to believe, however, that, in addition to this, it begets a certain weakness of constitution comparable to the increasing lack of fertility among themselves, which appears in a family that has been too closely bred for a series of successive generations.

BREEDING TOO YOUNG.

Breeding of immature animals is a strongly predisposing cause, as the demands upon the system for the nourishment of the offspring and at the same time for the dairy products interferes with the full development of the dam, rendering it weak and susceptible.

ILL-HEALTH.

The whole list of acute and still more of chronic diseases may be adduced as predisposing causes of tuberculosis, as they, one and all, leave the system weakened and susceptible.

On the contrary, in weak subjects exposed to tuberculosis among the best preventives are tonic remedies, like a bracing out-door life, a well developed muscular system, plenty of sunlight and preparation of iron, strontia, and cod liver oil. Among foods, such oleaginous agents as linseed, or rapeseed, or cotton seed would be especially commendable.

But some diseases are particularly strong in their predisposing influence. Diseases of the air passages and lungs are especially so by reason of their weakening the parts upon which the germs fall, and preparing a receptive field for their growth. The inhalation of dust and smoke are especially to

be feared, because they irritate, and produce a raw surface unusually favorable to the reception and growth of the bacillus.

On the part of the stomach, disorder of any kind paves the way for the successful passage of the bacillus through the gauntlet of the organ, and for its arrival in full vigor in the more favorable intestine. The bacillus tuberculosis lives in an alkaline or neutral material, and anything sour or acid is hurtful or fatal to it. In the acid secretion of the healthy stomach, therefore, it runs great risk of destruction, but under an attack of dyspepsia, when that secretion is suspended, or when all the food is not thoroughly digested, it may safely escape this danger and become fatally implanted on the alkaline bowel.

Then, again, nothing will more certainly undermine the vital powers than a confirmed dyspepsia, as without the digestion of the food there can be no absorption nor assimilation of the nutritive principles. Disorders of stomach and bowels are, therefore, among the most fruitful factors in bringing about tuberculosis, and in man especially the onset of the disease is often preceded by a persistent indigestion.

ANIMALS SUSCEPTIBLE TO TUBERCULOSIS.

Few, if any, diseases can boast a sway over a wider range of animals than tuberculosis. Among the domesticated animals cattle are perhaps most susceptible, but chickens, guinea-pigs, rabbits, swine, and goats follow closely on their heels. Some have thought that dogs, cats, sheep, and horses are exempt, but all contract the disease when inoculated with fresh tuberculous material. Their partial escape is, therefore, probably due in part to the greater amount of out-door life which they enjoy, and, in the case of horses and dogs, to the greater amount of exercise enjoyed, to the better condition of the muscular system, and to the greater constitutional vigor. Yet, after making all due allowance for these and other causes of exemption, it must be allowed that these four animals enjoy a native intolerance of the affection, to which the first named animals are strangers.

Among the less domesticated animals that contract tuberculosis may be named caged apes, lions, kangaroos, deer, elk, gazelle, antelope, and, in addition, the rats, mice, and other vermin of our houses and barns. All must, therefore, be considered as possible bearers and disseminators of the infection, and none must be ignored in any systematic attempt to *stamp out* the disease. Some, however, are justly considered to contribute more than others to the maintenance of the affection, and in this connection, in addition to man himself, we must especially name cattle, fowls, and pigs.

INDESTRUCTIBILITY OF THE BACILLUS TUBERCULOSIS.

Before referring to the rôle fulfilled by these different subjects in the propagation of tuberculosis, it seems desirable to learn something of the conditions which tend to destroy the vitality of the tubercle bacillus and those under which its survival may be expected.

DRYING AND HEATING.

Though the infecting material be *dried up* and reduced to powder, the germ is not destroyed, provided that too high a temperature has not been used in the drying. As this subject of destructibility by heat is a very far reaching one, I may be pardoned for dwelling on it a little more at length. Chauveau and Arloing found it infecting after having been heated to 158° F. for half an hour. Toussaint found that broiled steak, the interior of which had reached 163° to 176° F., was still infecting. Martin heated tuberculous matter in sealed tubes to 212°, but found that even then some germs would exceptionally escape. Chauveau and Arloing found that nothing survived half an hour of the boiling temperature, and Galtier found that 162° F. kept up for a length of time sterilized. This last temperature coagulates white of egg and other albumens, and, if continued so as to change the contents of the germ, it appears to sterilize it. Below this temperature, however, the blood in the interior of meat is not coagulated and discolored, but oozes out as a red fluid, and the germ survives. So much for eating the *rare* steaks of a tuberculous animal.

Now, this temperature which will coagulate albumen is not reached when tuberculous matters dry spontaneously in the open air. The dried up expectorations, therefore, are still infecting, and, as reduced to powder and blown about by the winds, these become prolific sources of infection. In barn yards, stock yards, and railroad cars this operates; and for man, in rooms, stores, and streets the same distribution of the poison takes place. It is now allowed that the handkerchief is one of the most prolific sources of infection. The expectoration dried up on the cloth is reduced to powder, and later shaken out on the air to be breathed by someone else. In the case of cattle the manger smeared with the discharge of the diseased animal dries up, and retains the virus in full strength for a subsequent occupant of the stall. We constantly see tuberculosis attack in succession the animals placed in the same stall, and those standing next the diseased one and privileged to eat out of the same manger. As the milder cases usually pass without recognition, it would be an admirable precaution to divide each stall from the next by a close partition at the front so that the cattle could neither lick each other nor a common manger. Then when a diseased animal is removed, the manger should either be destroyed and replaced by a new one, or thoroughly disinfected by a strong solution of chloride of lime. Another important precaution is that each animal should be trained to take its own particular stall, and not be allowed to go into any stall at random. This matter of the stall and manger is all important, as far more cases arise from this mode of infection than from breathing the same air or inhaling infected dust.

For the same reason persons affected with tuberculosis should not be allowed to attend in the stables, nor to expectorate on the floors nor the fodder of the animals. For man, sanitarians justly advise that all expectoration should be made into cuspidors containing water, to be disinfected and cleansed at frequent intervals, or into tissue paper, to be carefully burned as soon as possible.

By preventing the drying of the virulent discharges the

great danger of their diffusion on the air is overcome, but it does not by any means follow that when wet the material is harmless.

SURVIVAL IN WATER AND MOIST EARTH.

Galtier and others found that the infection was preserved indefinitely in springs, ponds, and wells of all ordinary temperatures. Hence the danger of common drinking troughs, of streams that have run past infected herds, or the place where their manure has been put, and of the soils that have received the manure and carcases of the diseased. Galtier failed to produce tuberculosis with vegetables grown on soils that had been manured with infecting material, but it is manifest that the survival of the germ in water implies its survival in the moist soil, and that the earth of such soil which clings to turnips, beets, potatoes, and other roots and tubers is not altogether free from danger. This is a slight danger, it is true, but it suggests the destruction of infected manure by burning or disinfectants, and of the carcases by burning or boiling rather than by simple burial. If buried it should be where no root crops are to be grown for a year or two thereafter.

Freezing does not destroy the virus. Galtier kept tuberculous matter for two months in water at 39° to 50° F., and for four days at 27° F., and found it still infecting. In another case he kept such matter for two months at a temperature at all times under 54° F., and for five days at 16° F., yet it proved virulent. Neither the winter's frost, therefore, nor the common alternations of temperatures in the soil can be trusted to disinfect it, in a short time.

Putrefaction does not destroy the virulence of tuberculous matter. Cornil and Babes left such matter to putrify, and then dried it up, but found it still infecting. Mallassez and Vignal first dried such matters, then softened them in water and left them to putrify, but found them still virulent. Galtier kept such matters moist and putrid at a temperature varying from 38° to 48° F. for seventeen days, but found them still infecting.

Heavy salting in the case of meats appears fatal to the germ, but requires at least one month to make it effective. Galtier found that the virulence was unaffected after eight days in salt. After fifteen days it was found to be harmless to rabbits but still fatal to the more susceptible guinea-pig. After thirty days it was alike harmless to both. While allowing, then, that salt may destroy the tubercle bacillus, we must yet recognize that even in a concentrated form it acts with great tardiness, and considering the unequal state of saturation in different parts of a large mass of meat it would be foolhardy to trust to its efficiency as a general precautionary measure. This caution is reinforced by the fact that Galtier found that salted pressed cheese was still infecting after the lapse of eleven months.

All this goes to show that the tubercle bacillus, which absorbs so very slowly any coloring matter, is equally tardy in taking in other materials that may be unfavorable to it, and that it may thus easily survive many conditions which prove destructive to most other bacteria. Hence the necessity adopting special precautions against its preservation, and transmission through the meat products and excretions of tuberculous animals.

FOOD PRODUCTS OF TUBERCULOUS ANIMALS.

I have already stated that tuberculous matter is liable to infect the bowels, abdominal lymphatic glands and liver when taken in as food, and, above all, in the case of a dyspeptic. The rule, however, is that we all have frequent temporary derangements of the stomach, and therefore no one can count on impunity if he eat tuberculous meat. Among animals the evidence of this is abundant, especially in the case of the young living on infected milk. A few years ago, at a large public institution in New York, the hogs fed the offal of the tuberculous cattle slaughtered, became in great proportion tubercular. In the way of direct experiment Zurn, Gerlach, Johne, Kolb, Toussaint, Chauveau, and a host of others have conveyed tuberculosis to guinea-pigs, rabbits, fowl, swine,

dogs, cats, and other animals by feeding tuberculous products. All did not suffer, but a considerable number, embracing all the different species of animals named, became tuberculous. In three hundred and twenty-two experiments recorded by Johne, 13 per cent became tuberculous.

The *red flesh* is usually remarkably free from tuberculous deposits, and it has been claimed that its juices are destructive to the bacillus, and that flesh can, therefore, be eaten with impunity. To determine this Schmidt fed the flesh of a tuberculous ox to fowls, and produced abdominal tuberculosis. Toussaint fed it to pigs, Viseur to cats, and Galtier to sheep and rabbits with the same result. All that can be said for flesh is that in cattle it is less frequently the seat of tubercle than the internal organs, and that, therefore, the eating of it is somewhat less dangerous. That it cannot be considered harmless may be inferred from the fact that, in advanced or generalized tuberculosis, the bacillus is found in the circulating blood, and that the blood contained in the capillary vessels of the muscles (red flesh) is therefore infecting. There is the further consideration, that the lymphatic glands, which are the favorite seats of tubercle in all parts of the body, are quite numerous in the muscular system, and the enlarged tuberculous glands beneath the skin and between the muscles become valuable means of recognizing the disease. The groups of such glands most commonly affected in cattle are those situated around the throat, beneath the tongue, in front of the shoulder blade, inside of the elbow, in front of the first rib, in front of the stifle, and in contact with the udder. In addition to these are many smaller masses of gland tissue, not recognizable without the microscope in health, but which in tuberculosis often stand out as peas, beans, or hazel nuts under the skin. These are most commonly found on the side of the belly, between the last rib and the hip bone. Then there are many groups of lymphatic glands more deeply ensconced in the muscles, and others in contact with the breast and back bones, which are beyond the reach of examination in life, but all of which go with the dressed carcase and contaminate the beef

as sold. Finally, in swine, in place of the juice of the muscle forbidding the invasion of the bacillus, this tissue becomes a favorite seat of the rather soft tubercles. The flesh of tuberculous swine is, therefore, more dangerous as a food than that of the infected ox.

It is only fair to say that the juice of the apparently sound muscle of an ox with localized deposits of tuberculosis is less dangerous than are distinctly diseased parts. Chauveau and Arloing found that guinea-pigs fed tubercles from cows were, without exception, rendered tuberculous, while others fed the muscle juice of the same animals became affected only in the proportion of eight per cent. Nocard and Galtier, respectively, by inoculating with the muscle juice of tuberculous cows infected in the different attempts 5 and 5½ per cent. This is a small percentage of infection, but that there was any infection at all goes to condemn the whole carcase, for no one can tell whether the bacilli are confined to one part or uniformly diffused, and if they are uniformly distributed, as is altogether the most probable, then the carcase of four hundred pounds must presumably contain a large number of germs, and must endanger a great number of consumers.

If the flesh of animals with even local tuberculosis must be eaten, it should only be done as canned meat, which has been subjected to prolonged heating, and in what has been boiled or fried any shade of the red, bloody color should be warrant for rejecting it.

That such meat is put upon the market is all too certain. Nor is it to be recognized by any faulty or defective appearance. German reports inform us that, of the tuberculous cattle found in their abattoirs 24 per cent furnish beef that would pass as the first quality; 44 per cent as of second quality; and 27 per cent as of third quality.

Milk is also a dangerous medium of infection. This is especially so if the udder is itself involved in the disease — a very frequent condition of things. Bang, Galtier, May, Nocard, and Bollingér all produced tuberculosis by inoculating with such milk. Woodhead and McFadyean produced the

disease in six out of thirty-one trials. Apart from the udder disease, the milk is especially likely to prove infecting when tuberculosis has become generalized, the tubercles being extensively distributed through the body. In such a case the bacilli have invaded the blood to a large extent, and they pass through every organ in which the blood circulates. Hence the milk is almost constantly contaminated.

It is not always easy to determine that the udder is absolutely free from tubercle, but in cases in which it is apparently free the milk is still frequently infecting.

Bang produced tuberculosis by injecting such milk, once only in twenty-eight times, Ernst in 37.5 per cent of his trials with guinea-pigs, and 15.5 per cent of rabbits. Schmidt-Muhlheim, May, Stein, Baumgarten, Fischer, Herschberger, Gunther and Harms, Siedamgrotzky, Gerlach, Peuch, and Hedley were also successful in producing tuberculosis with such milk. Baum says that the milk of tuberculous cows is infecting in 60 to 70 per cent of the cases.

This is a question of surpassing importance, considering how much milk is used on our tables daily; how universally it is fed to infants and invalids, and how the skimmilk, buttermilk, and whey are fed to our calves, swine, and fowls. For the farmer's own profit it is imperative that he eradicate this scourge from his herd, and it is a question of life or death with the child or invalid whether he can get his milk free from the bacillus.

Whey, *skimmilk*, and *buttermilk*, are, as a matter of course, infecting if obtained from infecting milk.

Butter appears to have been less frequently put to the test than other dairy products. Bang, however, put a rabbit on the butter of a tuberculous cow, and in three months it died tuberculous.

Cheese has also been comparatively little investigated. Galtier, however, fed to two guinea-pigs cheese made from the milk of tuberculous cows eleven months before, and he thereby infected the guinea-pigs. The tuberculosis in the guinea-pigs was successfully inoculated from these animals

upon others, so that no doubt remained as to the true nature of the affection. At the end of the twelfth month he found this cheese no longer infecting.

RELATION OF TUBERCULOSIS IN MAN AND BEAST.

I never speak on this subject without dreading that I shall be thought an alarmist. I certainly have no intention of acting that part. For thirty years I have believed tuberculosis contagious, and that it was transmitted from beast to man, as well as from man to beast. But the public mind was not prepared to act on such a belief. Fifteen years ago, when dealing with the lung plague of cattle, I was often urged to make a clean sweep by dealing with tuberculous cows as we did with the lung plague ones. I dissuaded my coworkers at that time on the ground of policy. There was at that time no public spirit to sustain us in such a course, and there was not sufficient money available to pay for the animals killed. But times have changed; the lung plague we have extirpated from the continent, and men's minds are open to the importance of tuberculosis, a subject far closer to the home and heart than lung plague ever could be. Lung plague affected the pocket, robbing us of a few millions a year, tuberculosis costs us our household treasures, our strong men and tender women, our laughing children, and our reverenced parents. The time is come to speak the truth on this matter, not in the impassioned words of an alarmist, but in a sober statement of fact. The dealing with a disease of this kind is by no means the simple matter of dealing with lung plague. *That* affected cattle only, and could be crushed out speedily and effectually by the extinction of the whole infected herd and the disinfection of the premises. Tuberculosis, on the other hand, may be maintained by almost any genius of animal, wild or tame; it may be carried by prowling vermin or migrating birds, and finally, as occuring in man it cannot be instantly done away with, but must be recognized as a standing menace to his neighbors and his animal dependents. We cannot, therefore, expect the same speedy and thorough effects with tuberculosis that were

obtained with lung plague. But, none the less, we are called upon by every consideration of humanity, and by every rule of personal and political economy, to begin the good work which shall one day result in the extinction of this scourge of our civilization in house and herd alike.

At present in the human population of New York State every eighth death is from consumption. No other single disease at all approaches this in the number of its victims. Yet practically nothing is being done to restrict its ravages. Now, I don't say that the extinction of this disease in farm animals would put a stop to the affection in man. Man contracts the disease from man to a greater extent, doubtless, than he does from all the domestic animals together. But, at the same time, no inconsiderable amount of human tuberculosis is undoubtedly contracted from the lower animals, and this important source of infection, which can certainly be cut off with great profit to the stock owner, should be done away with at once.

To take but the one source, that of our dairy herds, we find that, where cattle are few or absent, or where they are kept all the time in the open air, and are, therefore, little exposed to infection, consumption is usually less prevalent in the human family. Among such places I may name Northern Norway, Sweden, Lapland, and Finland, where reindeer replace the cattle; Hudson Bay, and the islands of the Pacific, where no cattle exist; and the Scottish Hebrides, Iceland, and Newfoundland, where cattle are few. In Algiers, though a resort for consumptives, yet cattle are few, and live apart from the cities and in the open air, and tuberculosis does not increase. In Italy, on the northern shore of the same sea, where cattle are housed, tuberculosis has become the scourge of man and beast. In Australia, the great resort of the English consumptive, the disease, formerly unknown, has become exceedingly prevalent, and the same already promises to be the case for our own Minnesota. The Indians of the Northwest furnish the most striking illustration of the infection derived from cattle, and fostered by unwholesome conditions

of life. Dr. Treon, in the "American Practitioner," describes the poor, emaciated, diseased animals furnished to the Indians, how the Indians eat the liver, tallow, and entrails raw, and how the beef which is to be preserved is dried, pounded, and packed in skins to be eaten later without cooking. Frequently they eat animals that have died of disease, and from the mode of dividing the beef, it is probable, he says, that at least one hundred persons may become inoculated by a single diseased animal. Dr. Holder, in the "Medical Record" (August 13, 1892), gives us some of the results. At Green Bay, Wis., Tulalip, Wash., and Western Shoshone, Nev., 50 per cent of the total Indian mortality is from tuberculosis; at Lower Brulè, Dak., scrofula is present in 60 per cent of the Brulè Sioux under 21 years, and at Crow Creek, Dak., fifty out of a total Indian population of 1,200 die every year of consumption and scrofula. Apart from increase, this would kill out the race in twenty-four years. This is the dark side of the question, and is worthy of study by those who think that the dangers of tuberculosis in cattle are too insignificant to demand serious attention.

If that is the lesson as to cattle, it is no less so as regards pigs and fowls. Both of these classes are kept about slaughter-houses, and both fed on the offal uncooked, and, therefore, in the best possible condition to convey tuberculosis. All the diseased parts that are unmarketable go to them, and if any carcase is altogether unfit for sale, it can at least make pork and eggs. Now, I have no objection to such disposal of the refuse if it were first submitted to several hours' hard boiling. But as matters are now, so long as our herds furnish tuberculous animals to the slaughter-house, so long will tuberculosis be systematically developed in the hogs and fowls. Nor is it in the slaughter-houses alone that this culture of the contagion is ignorantly conducted. In a recent visit to Madison county, N. Y., where one herd had furnished six cases of tuberculosis, I found that neighboring farmers had secured the diseased carcases to feed their poultry. Under the delusion that cattle alone suffered they had set about planting the germs in their own homesteads and herds.

Let me repeat that tuberculous pigs are even more dangerous than tuberculous cattle, because the tubercles are formed to a greater extent among the flesh which comes to our tables, rather than in the internal organs which are cast aside. As regards tuberculous fowls, it is enough to say that the germ obtained from them is especially virulent and dangerous.

REMEDIAL MEASURES.

It follows from what I have said that measures for the restriction and extinction of tuberculosis must consist largely in a scientific dealing with our herds of domestic animals. Such control of our herds demands the employment of professional skill of the best kind. We are confronted with two dangers: one is the danger of ignoring a most deadly contagion and allowing it a free and unrestricted field for its ravages; the other is the risk of the exclusion of valuable products from the market, because the animals or herds furnishing them are wrongfully pronounced to be victims of tuberculosis. Recently, I have found in different parts of New York cattle that had been secluded for months as tuberculous when they only suffered from a chronic nasal catarrh, kept up by twigs which they had broken off inside the nose. The average New York veterinarian, created by act of the legislature, without *alma mater* and without education, does incomparably more harm than good in dealing with such diseases. Even the graduates of our veterinary schools, conducted as they are with a short and inadequate curriculum, and in large cities where the clinical education is confined practically to horses, are rarely equipped with the skill and experience necessary to such a work. But they are the best material ready to our hand, and by selection and training their ranks may furnish available agents.

The skill necessary to this work is of a high order, and the patient, careful, and truth-loving devotion required, is no less high. An acute or advanced case of tuberculosis of the lungs may be easily distinguished. There is extreme emaciation, a frequent dry, husky cough, profuse discharge from the nose

of a nauseous yellow, muco-purulent matter, with fine flakes, or even gritty particles, a heavy offensive odor to the breath, inappetence, sunken, bloodless eyes, a scurfy, unthrifty adherent hide, and general weakness and wretchedness. Then in the lungs are isolated patches that sound flat and solid on percussion, and there are sounds at intervals over the chest of wheezing or creaking, or like the bursting of fine bubbles, and a variety of other sounds which indicate the different morbid conditions. In such cases the condition may be all too evident, and it only lacks the microscopic demonstration of the bacilli to make the conclusion absolutely certain. But when the lung symptoms are obscure, the area of dullness and morbid sounds hidden under the thick muscular shoulder, or drowned by the loud continous rumbling of the bowels, when the tubercles are not in the lungs at all, but in the lymphatic glands in the chest or abdomen, or in the glands under the skin, in the liver, spleen, kidney, bones, or elsewhere, it may require all the skill of the most accomplished man to detect the affection, and even he may be finally left in the dark. He cannot, like the doctor, secure from the patient a history of the case, he cannot ask where there is pain or suffering, nor anything as to feelings that would be a valuable guide to the physician. If he examines the discharge from the nose and finds rod-shaped bacteria he must be skilled enough in the staining of these to say whether they are the germs of tubercle or of some other disease. In case even this fails, he may be thrown back on a graduated hypodermic injection of Koch's lymph, which will develop an elevated body temperature in the tuberculous and leave the non-tuberculous unaffected; or he may have to resort to the inoculating of another less valuable animal with the morbid products, and wait for the result.

When I say that these occult cases often constitute the majority, I only state what the inspector has many a time to deal with, and I intimate how difficult the work to which he is called, and the skill and care requisite to its successful performance.

Under such circumstances, the physician is even more helpless than the veterinarian. He may in some senses be a better educated man, though this is by no means always the case, but he finds himself so nonplused by the entire absence of all voluntary assistance from the patient, he is so much in the dark as to the position and relations of the different organs in the quadruped, so entirely unacquainted with the normal sounds and other indications to be expected in the different parts, and so ignorant of the different diseases of the animal that may be easily confounded with tuberculosis, and so uncertain of his ground at every step that his conclusions are quite as likely to be wrong as right, and it is only after a special training in the structure and diseases of animals that his medical skill can be availed of in this work.

The dissemination of sanitary knowledge among stock owners will be an important element in this general work. The purchaser cannot afford to take an animal from an unknown source, and even from a known herd he ought to seek with it substantial evidence that no animal from such herd has died or been disposed of for disease in recent years, and that no suspicious sickness exists in such herd at the time of sale. Above all, he should take no animal from a city or suburban dairy, nor from a swill stable. Healthy animals can be had from such places, but the risk is great and in the case of a disease so insidious as tuberculosis, he cannot afford to take the risk. Now cattle from country herds that have had, in the main, an out-door life can always be had, and with a knowledge of the previous soundness of the herd are greatly to be preferred.

Another important precaution is the inspection of cattle for slaughter. To make this efficient we must have something more than the perfunctory inspection of the dressed meat in the butcher's stall. Under such a system some of the most dangerous diseases which affect the blood or internal organs without injuring the appearance of the meat are inevitably thrown on the market. Many cases of tuberculosis, in which the lungs and lymphatic glands of chest and abdomen are

affected, would present fair carcases. In German abattoirs the tuberculous animals furnished what appeared first quality beef to the extent of 24 per cent of their numbers.

The skilled inspector must, therefore, examine animals before death and during slaughtering, and instruments and methods of precision must be called into requisition when necessary to determine the true nature of the case. Such inspection, however, demands a public municipal slaughter-house, under strict sanitary regulations, and where all butchers can hire at low rates all facilities necessary for slaughtering and for utilizing the products. In the great cities of Europe such institutions are conducted most profitably not only on the ground of sanitation, but of economy and inoffensiveness as well. In the Edinburgh abattoir a slaughtering booth, pen, and yard, with all facilities for utilization of the products can be rented for $40 a year.

Such municipal abattoirs are also the true remedy for the existing system by which the market for fat stock and that for dressed meat are both controlled by a few great packers, who have set up mammoth establishments at the great centres of the cattle trade. Under the existing system by which the United States Government furnishes official inspectors at such centres and denies them elsewhere, thereby giving to these packers and to no one else certificates which will secure them the admission of their meat products into the markets of Europe, it gives to these packers a virtual control and monopoly of the market at home and abroad; for, having the exclusive disposal of all the surplus, they can practically dictate prices to both farmer and consumer.

A system so manifestly unrepublican and unjust cannot continue, and its proper remedy lies in the establishing of municipal abattoirs and inspectorships which shall place all good meats on a par, and will at once serve to purify our herds and protect the health of the public.

I must not close without emphasizing the importance of a due consideration of property rights.

Sanitary laws which in any way ignore or disregard the

rights of property have within themselves the seeds of defeat. If in our municipal abattoir the butcher cannot conduct his business as well and economically as he could in his own establishment, he or his competitors will circumvent or evade the law in some way. If the stock owner is not fairly reimbursed for his animals slaughtered for the protection of the public health and the purifying of the herds of the country, unscrupulous men will find ample means of trading off the as yet incipient and occult cases of tuberculosis, and of scattering the infection widely in new herds. Compensation must stop short of making the sanitary bureau a profitable customer for animals at sound prices, but it must be so liberal as to enlist the ready coöperation of the owner of the sick beast in having it disposed of.

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